Annual Activity Report
Faculty of Chemical Technology
University of Pardubice

2021

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University of Pardubice

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Introduction

Dear readers, this publication is the Annual Report for 2021 presented to the general public by the Faculty of Chemical Technology, University of Pardubice in compliance with Act No. 111/1998 Coll. on Higher Education Institutions and on amendment to some acts. In this Annual Report, the management of the faculty present significant activities and results of the Faculty of Chemical Technology in the context of the University of Pardubice, in the framework of Czech and international education and in terms of scientific and research activities.

1. Structure of the Faculty Bodies

1.1 Faculty Management

Dean:	Prof. Ing. Petr Kalenda, CSc.
Vice-Deans:	Prof. Ing. Petr Němec, Ph.D. *Vice-Dean for Education, First Deputy Dean*
	Prof. Ing. Petr Mošner, Dr. *Vice-Dean for Science and Development*
	Mgr. Lucie Stříbrná, Ph.D. *Vice-Dean for External Relations and Promotion*
Secretary:	Ing. Martin Šprync

1.2 Departments and Institutes of the Faculty

Departments and Institutes

Department of General and Inorganic Chemistry (KOAnCh)
Head of Department: Prof. Ing. Zdeněk Černošek, CSc.

Institute of Organic Chemistry and Technology (ÚOChT)
Head of Institute: Prof. Ing. Miloš Sedlák, DrSc.

Department of Analytical Chemistry (KAlCh)
Head of Department: Prof. Ing. Karel Ventura, CSc.

Department of Biological and Biochemical Sciences (KBBV)
Head of Department: Prof. Mgr. Roman Kanďár, Ph.D.

Department of Physical Chemistry (KFCh)
Head of Department: Prof. Ing. Libor Čapek, Ph.D.

Institute of Chemistry and Technology of Macromolecular Materials (ÚChTML)
Head of Institute: Doc. Ing. David Veselý, Ph.D.

Institute of Environmental and Chemical Engineering (ÚEnviChI)
Head of Institute: Prof. Ing. Petr Mikulášek, CSc.

Department of Economy and Management of Chemical and Food Industry (KEMCh)
Head of Department: Ing. Jan Vávra, Ph.D.

Department of Inorganic Technology (KAnT)
Head of Department: Prof. Ing. Petra Šulcová, Ph.D.

Institute of Applied Physics and Mathematics (ÚAFM)
Head of Institute: Prof. Ing. Čestmír Drašar, Dr.

Department of Graphic Arts and Photophysics (KP)
Head of Department: Prof. Ing. Petr Němec, Ph.D.

Institute of Energetic Materials (ÚEnM)
Head of Institute: Doc. Ing. Miloš Ferjenčík, Ph.D.

Centre of Materials and Nanotechnologies (CEMNAT)
Head of Centre: Prof. Ing. Miroslav Vlček, CSc.

Joint Laboratory of Solid State Chemistry (SLChPL)
Head of Laboratory: Doc. Ing. Eva Černošková, CSc.

Centres

University Environmental Centre
Head of Centre: Prof. Ing. Petr Mikulášek, CSc.

1.3 Academic Senate of FChT

Chair: Doc. Ing. Martin Adam, Ph.D.

Board: Doc. Ing. Martin Adam, Ph.D.
Ing. Aleš Eisner, Ph.D.
Ing. Lada Dubnová

Members: Doc. Ing. Martin Adam, Ph.D.
Doc. Ing. Marek Bouška, Ph.D.
Prof. Ing. Čestmír Drašar, Dr.
Ing. Lada Dubnová
Ing. Aleš Eisner, Ph.D.
Prof. Ing. Roman Jambor, Ph.D.
Doc. Ing. Alena Komersová, Ph.D.
Bc. Petr Leinweber
Ing. Patrik Pařík, Ph.D.
Bc. Jakub Staněk (from 29 November 2021)
Bc. Martin Šimek (until 8 September 2021)
Ing. Pavel Šimon (until 24 November 2021)
Ing. Diego Alejandro Valdés Mitchell
Doc. Ing. David Veselý, Ph.D.
Prof. Ing. Jaromír Vinklárek, Dr.
Bc. Lukáš Vlk (from 23 September 2021)
Doc. Ing. Tomáš Weidlich, Ph.D.

1.4 Scientific Board of FChT

Chair: Prof. Ing. Petr Kalenda, CSc., Dean of the Faculty of Chemical Technology

Internal Members:
Prof. Ing. Libor Čapek, Ph.D.
Prof. Ing. Zdeněk Černošek, CSc.
Prof. Ing. Čestmír Drašar, Dr.
Prof. Ing. Radim Hrdina, CSc.
Prof. Ing. Jaromíra Chýlková, CSc.
Prof. Ing. Roman Jambor, Ph.D.
Prof. Ing. Pavel Jandera, DrSc. (until 4 August 2021)
Prof. Mgr. Roman Kanďár, Ph.D.
Prof. Ing. Jiří Kulhánek, Ph.D.
Prof. Ing. Jiří Málek, DrSc.
Prof. Ing. Petr Mikulášek, CSc.
Prof. Ing. Petr Mošner, Dr.
Prof. Ing. Petr Němec, Ph.D.
Prof. Ing. Aleš Růžička, Ph.D.
Prof. Ing. Miloš Sedlák, DrSc.
Prof. Ing. Petra Šulcová, Ph.D.
Doc. Ing. Liběna Tetřevová, Ph.D.
Prof. Ing. Ladislav Tichý, DrSc.
Prof. Ing. Karel Ventura, CSc.
Prof. Ing. Jaromír Vinklárek, Dr.
Prof. Ing. Svatopluk Zeman, DrSc.

External Members:

Prof. RNDr. Jiří Barek, CSc.	Faculty of Science, CU, Prague
Prof. Ing. Roman Čermák, Ph.D.	Dean, Faculty of Technology, TBU Zlín
Prof. Ing. Anton Gatial, DrSc.	Dean, Faculty of Chemical and Food Technology, SUT Bratislava
Mgr. Karolína Gondková	Director of the Higher Education Department, Ministry of Education Prague
Prof. Ing. Jiří Hanika, DrSc.	Institute of Chemical Process Fundamentals of the Czech Academy of Sciences
Prof. Ing. Kamila Kočí, Ph.D.	Faculty of Metallurgy and Material Engineering, Institute of Environmental Technology, VSB-TU Ostrava
Doc. Ing. Zdeňka Kolská, Ph.D.	Faculty of Science, JEPU Ústí nad Labem
Ing. Josef Liška	CEO, Synthesia, a.s., Pardubice
Ing. David Pohl, Ph.D.	Managing Director, Synthos, a.s., Kralupy nad Vltavou
Prof. Ing. Václav Švorčík, DrSc.	Faculty of Chemical Technology, UCT Prague
Prof. Ing. Martin Weiter, Ph.D.	Dean, Faculty of Chemistry, BUT Brno

1.5 Study Programme Board

Chair: Prof. Ing. Petr Němec, Ph.D.

Deputy Chair: Prof. Ing. Petr Mikulášek, CSc.

Members:
Prof. RNDr. Zuzana Bílková, Ph.D.
Prof. Ing. Libor Čapek, Ph.D.
Doc. Ing. Libor Červenka, Ph.D.
Doc. Ing. Pavel Čičmanec, Ph.D.
Doc. Ing. Jan Fischer, CSc.
Prof. Ing. Jiří Hanusek, Ph.D.
Doc. RNDr. Jana Holubová, Ph.D.
Doc. Ing. Aleš Imramovský, Ph.D.
Doc. Ing. Zdeněk Jalový, Ph.D.
Doc. Ing. Petr Janíček, Ph.D.
Prof. Ing. Petr Kalenda, CSc.
Prof. Ing. Andréa Kalendová, Dr.
Prof. Mgr. Roman Kanďár, Ph.D.
Doc. Ing. Anna Krejčová, Ph.D.
Prof. Ing. Petr Mošner, Dr.
Doc. Ing. Marcela Pejchalová, Ph.D.
Doc. RNDr. Tomáš Roušar, Ph.D. (from 1 November 2021)
Prof. Ing. Aleš Růžička, Ph.D.
Prof. Ing. Petra Šulcová, Ph.D.
Doc. Ing. Liběna Tetřevová, Ph.D.
Ing. Jan Vávra, Ph.D. (from 1 March 2021)
Doc. Ing. David Veselý, Ph.D.

1.6 Advisory Bodies of the Faculty Management

Disciplinary Commission

Chair: Prof. Ing. Petr Němec, Ph.D., Vice-Dean for Education

Members: Prof. Ing. Petr Mikulášek, CSc., Head of ÚEnviChI
Doc. Ing. David Veselý, Ph.D., Head of ÚChTML
Ing. Barbora Kamenická, doctoral degree student (until 30 April 2021)
Ing. Jakub Šulc, doctoral degree student (until 30 April 2021)
Ondřej Kovář, bachelor's degree student (until 30 April 2021)
Ing. Michal Kašpar, doctoral degree student (from 1 May 2021)
Ing. Petr Resl, doctoral degree student (from 1 May 2021)
Anna Gondková, bachelor's degree student (from 1 May 2021)

Investment Commission

Chair: Prof. Ing. Petr Mošner, Dr., Vice-Dean for Science and Development

Members: Representatives of all departments/institutes

Commission for handling surplus and useless property of FChT and for precious metal write-off

Chair: Ing. Martin Šprync, Secretary

Members: Doc. Ing. Petra Bajerová, Ph.D., KAlCh
Doc. Ing. David Veselý, Ph.D., Head of ÚChTML

Assessment board for the applications for habilitation procedure and professor appointment procedure

Chair: Prof. Ing. Petr Mikulášek, CSc.

Members: Prof. Ing. Petr Němec, Ph.D.
Prof. Ing. Petr Mošner, Dr.
Prof. Ing. Jiří Kulhánek, Ph.D.
Head of the respective FChT department or another significant professional in the field

2. Study and Educational Activity

2.1 Full-time and Part-time Study Programmes (Fields of Study)

The current study programmes at FChT include 18 bachelor's degree programmes (of which 10 are newly accredited), 22 follow-up master's degree programmes (of which 16 are newly accredited) and 18 doctoral degree programmes (of which 11 are newly accredited, also in English); in total, the faculty offers 58 forms of study.

In the academic years 2020/2021 and 2021/2022, the following accredited study programmes were available:

Study programme		**Field of study**	**Standard length of study (years)**			**CBBE Code**
			Bc.	F-Mgr.	Ph.D.	
B3912	Special chemical and biological programmes	Clinical biology and chemistry	3			3901R017
		Laboratory assistant	3			5345R020
B3441	Graphic arts and printing technology	Graphic arts and printing technology	3			3441R001
B2807	Chemical and process engineering	Environmental protection	3			1604R007
B2802	Chemistry and technical chemistry	Chemistry and technical chemistry	3			2802R011
B2901	Chemistry and technology of foodstuffs	Evaluation and analysis of foodstuffs	3			2901R003
B2829	Inorganic and polymeric materials	Inorganic materials	3			2808R023
		Polymeric materials and composites	3			2808R024
B2830	Pharmacochemistry and medicinal materials	Pharmacochemistry and medicinal materials	3			2801R021
B2831	Surface protection of building and construction materials	Surface protection of building and construction materials	3			2808R025
N3441	Graphic arts and printing technology	Graphic arts and printing technology		2		3441T001
N3912	Special chemical and biological programmes	Bioanalyst		2		1406T011
N2901	Chemistry and technology of foodstuffs	Evaluation and analysis of foodstuffs		2		2901T003
N2807	Chemical and process engineering	Economy and management of chemical and food industry		2		2807T015
		Chemical engineering		2		2807T004
		Environment protection		2		1604T007
N2808	Chemistry and technology of materials	Inorganic technology		2		2801T001
		Chemistry and technology of paper and pulp		2		2808T015
		Material engineering		2		3911T011
		Organic coatings and paints		2		2808T022
		Technology of organic specialities		2		2801T007
		Technology of polymers manufacturing and processing		2		2801T009
		Theory and technology of explosives		2		2801T010
		Fibres and textile chemistry		2		2806T003
N1407	Chemistry	Analytical chemistry		2		1403T001
		Inorganic and bioinorganic chemistry		2		1401T001
		Organic chemistry		2		2802T003
		Technical physical chemistry		2		2802T010
P1418	Inorganic chemistry	Inorganic chemistry			4	1401V002

P1421	Organic chemistry	Organic chemistry			4	1402V001
P1419	Analytical chemistry	Analytical chemistry			4	1403V001
P1420	Physical chemistry	Physical chemistry			4	1404V001
P2832	Chemistry and chemical technology	Inorganic technology			4	2801V001
		Organic technology			4	2801V003
P2833	Chemistry and technology of materials	Surface engineering			4	2808V027
		Chemistry and technology of inorganic materials			4	2808V003
		Engineering of energetic materials			4	2808V035
P2837	Chemical and process engineering	Chemical engineering			4	2807V004
		Environmental engineering			4	3904V005

Newly accredited study programmes from academic year 2019/2020

Accredited study programme			**Standard length of study** (years)		
			Bc.	**F-Mgr.**	**Ph.D.**
B0488A050003	Economy and management of chemical industry enterprises		3		
B0512A130006	Analysis of biological materials		3		
B0531A130012	Pharmacochemistry and medicinal materials		3		
B0531A130013	Surface protection of building and construction materials		3		
B0531A130014	Graphic arts and printing technology		3		
B0588A130001	Chemistry and Technology of Environment Protection		3		
B0531A130017	Polymeric materials and composites		3		
B0531A130013	Inorganic and bioinorganic materials		3		
B0531A130024	Evaluation and analysis of foodstuffs		3		
B0531A130025	Chemistry		3		
N0413A050010	Economy and management of chemical industry enterprises			2	
N0512A130006	Analysis of biological materials			2	
N0531A130013	Graphic arts and printing technology			2	
N0711A130008[e)] N0531A130017	Engineering of Energetic Materials			2	
N0914P360001	Bioanalytical Laboratory Diagnostics in Medicine			2	
N0531A130028	Analytical chemistry			2	
N0531A130029	Inorganic and bioinorganic chemistry			2	
N0531A130030	Evaluation and analysis of foodstuffs			2	
N0531A130031	Material engineering			2	
N0531A130035	Physical chemistry			2	
N711A130013	Chemical and process engineering	Chemical engineering		2	
		Environment protection		2	
N711A130014	Sustainable development in chemistry and technology			2	
N711A130015	Inorganic technology			2	
N0531A130047	Organic chemistry and technology	Organic chemistry		2	
		Technology of organic specialities		2	
N0531A13032[e)]	Materials chemistry			2	
P0711D130001 P0711D130002[e)]	Organic technology				4
P0531D130009 P0531D130010[e)]	Analytical chemistry				4
P0531D130011 P0531D130012[e)]	Inorganic chemistry				4
P0711D130025 P0711D130028[e)]	Inorganic technology				4
P0512D130013 P0512D130014[e)]	Biochemistry				4
P0531D130052 P0531D130054[e)]	Physical chemistry				4

P711D130027 P0711D130026[e)]	Chemical and process engineering	Chemical engineering			4
		Environmental engineering			4
P0531D130013 P0531D130014[e)]	Chemistry and technology of inorganic materials				4
P0531D130053 P0531D130051[e)]	Engineering of energetic materials				4
P0531D130015 P0531D130016[e)]	Organic chemistry				4
P0413D050023 P0413D050024[e)]	Economics and management of businesses with process manufacturing operations				4

[e)] Teaching in English

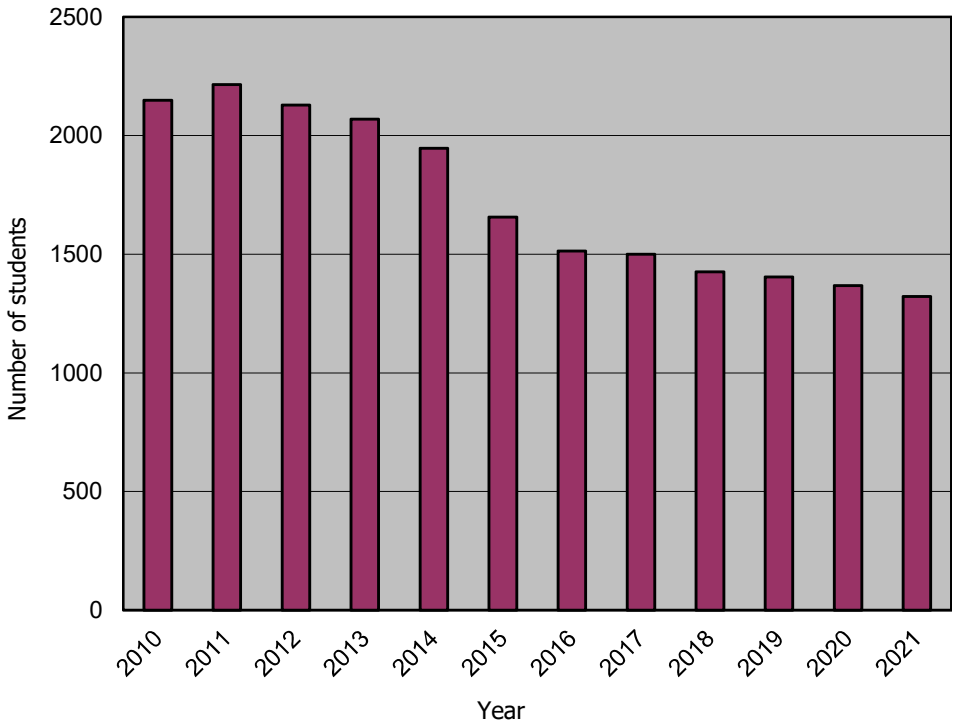
2.2 Numbers of Students in Bachelor's, Master's and Doctoral Degree Programmes

The numbers of students of the faculty (always as of 31 October of the relevant year) are shown in the tables and graphs below. The letter *c* indicates international students.

Development of the overall number of students at FChT

Year	2010	2011	2012	2013	2014	2015
Number of students	2058+91c	2124+91c	2047+82c	1975+95c	1840+106c	1542+115c

Year	2016	2017	2018	2019	2020	2021
Number of students	1377+137c	1353+147c	1276+150c	1262+142c	1236+132c	1190+132c



Development of the overall number of students at FChT between 2010 and *2021*

Numbers of students by type of study

Form and type of study	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
Czech students	1377	1353	1276	1262	1236	1190
Foreign students	137c	147c	150	142	132	132
Students total	**1514**	**1500**	**1426**	**1404**	**1368**	**1322**
Full-time study Bachelor's degree programmes Follow-up master's programmes	 875+95c 326+14c	 857+99c 332+22c	 841+99c 278+27c	 866+95c 268+26c	 859+78c 264+25c	 813+85c 264+20c
Full-time total	**1201+109c**	**1189+121c**	**1189+121c**	**1134+121c**	**1123+103c**	**1077+105c**
Part-time study Bachelor's degree programmes Follow-up master's programmes	 2+0c 0	 1+0c 0	 1+0c 0	 **-** **-**	 **-** **-**	 **-** **-**
Part-time total	**2+0c**	**1+0c**	**1+0c**	**-**	**-**	**-**
Doctoral degree programmes	**174+28c**	**163+26c**	**156+24c**	**128+21c**	**113+29c**	**113+27c**

Number of full-time students by study programmes

Study Programme	2019/2020		2020/2021		2021/2022	
	Bc.	N	Bc.	N	Bc.	N
Chemistry and technical chemistry	123+7c	-	56+3c	-	33+2c	-
Chemistry and technology of foodstuffs	96+11c	28+4c	56+5c	20+2c	28+1c	2+1c
Graphic arts	14+1c	12+2c	10+1c	2+1c	7+0c	1+0c
Special chemical-biological fields	342+27c	30+2c	340+23c	8+0c	333+26c	2+0c
Chemical and process engineering	29+1c	-	19+1c	-	1+0c	-
Pharmacochemistry and medicinal materials	55+11c	-	32+4c	-	5+0c	-
Surface protection of building and construction materials	10+0c	-	6+0c	-	-	-
Inorganic and polymeric materials	35+3c	-	16+2c	-	9+1c	-
Chemical and process engineering – N2807	-	24+3c	-	7+1c	-	-
Chemistry and technology of materials -	-	57+5c	-	38+6c	-	33+5c
Chemistry - N1407	-	58+7c	-	34+4c	-	9+3c
Economy and management of chemical industry enterprises*	22+2c	7+0c	31+4c	10+0c	30+4c	13+0c
Analysis of biological materials	31+11c	13+2c	40+6c	27+5c	49+12c	25+3c
Pharmacochemistry and medicinal materials	55+17c	-	69+14c	-	94+18c	-
Surface protection of building and construction materials	1+0c	-	11+0c	-	17+0c	-
Graphic arts and printing technology*	16+2c	11+0c	29+1c	13+0c	38+2c	7+1c
Chemistry and technology of environment protection*	26+1c	-	30+3c	-	22+5c	-
Polymeric materials and composites*	11+1c	-	12+4c	-	11+3c	-
Engineering of energetic materials*, e)	-	2+0c	-	2+0c	-	-

Bioanalytical laboratory diagnostics in medicine*		-	26+1c	-	46+2c	-	54+1c
Inorganic and bioinorganic materials*		-	-	17+0c	-	21+1c	-
Organic chemistry and technology	Organic chemistry*	-	-	-	-	-	10+0c
	Technology of organic specialities*	-	-	-	-	-	1+0c
Evaluation and analysis of foodstuffs*		-	-	35+4c	-	50+4c	-
Chemistry*		-	-	50+3c	-	65+6c	-
Engineering of energetic materials*		-	-	-	4+0c	-	9+0c
Analytical chemistry*		-	-	-	10+1c	-	21+2c
Inorganic and bioinorganic chemistry*		-	-	-	5+0c	-	6+0c
Evaluation and analysis of foodstuffs*		-	-	-	12+3c	-	30+4c
Material engineering*		-	-	-	7+0c	-	12+0c
Physical chemistry*		-	-	-	6+0c	-	7+0c
Chemical and process engineering	Chemical engineering	-	-	-	3+0c	-	3+0c
	Environment protection	-	-	-	3+0c	-	5+0c
Sustainable development in chemistry and technology		-	-	-	4+0c	-	9+0c
Inorganic technology		-	-	-	3+0c	-	5+0c
Total		**1134+121c**		**1123+103c**		**1077+105c**	

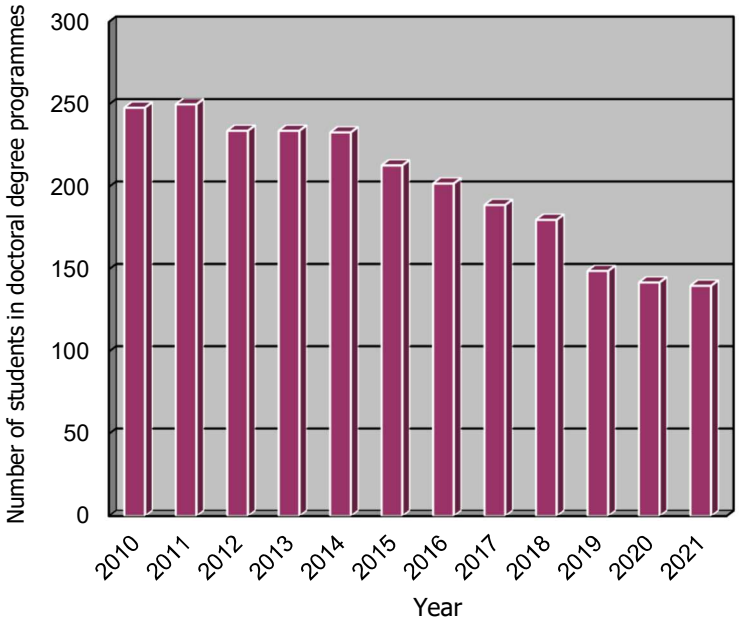
* Newly accredited programmes
e) Teaching in English

Development of the number of students in doctoral degree programmes at FChT

Year	**2010/11**	**2011/12**	**2012/13**	**2013/14**	**2014/15**	**2015/16**
Number of students	248	250	234	234	233	213
Proportion of the overall number of students (%)	11.5	11.3	11.0	11.3	11.9	12.8

Year	**2016/17**	**2017/18**	**2018/19**	**2019/20**	**2020/21**	**2021/22**
Number of students	202	189	180	149	142	140
Proportion of the overall number of students (%)	13.3	12.6	12.6	10.6	10.3	10.5

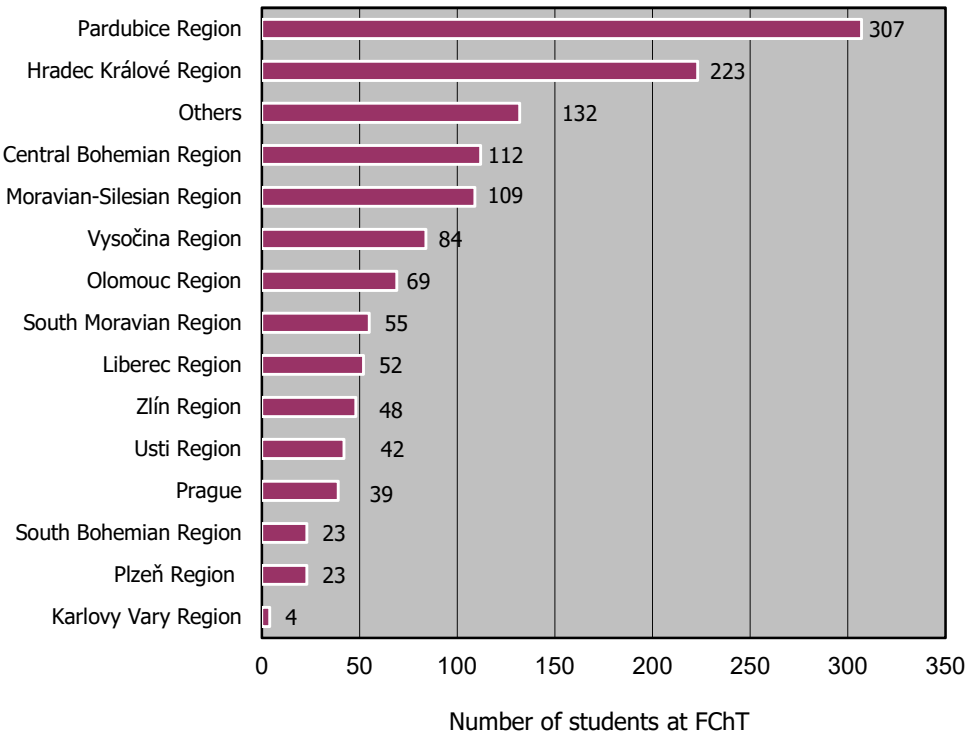
In 2021 the proportion of doctoral degree students was above 10 % of the total number of students at FChT. The current proportion is 10.5 %.



Development of the number of students in doctoral degree programmes at FChT between 2010 and *2021*

Number of students at FChT by regions

The largest number of students are from the Pardubice and Hradec Králové Regions. A positive fact is that FChT is also chosen by students from the Vysočina and Central Bohemian Regions, in addition to the traditional catchment area of Moravia. A significant proportion of the total number of students is represented by foreigners (column Others). The following graph shows the geographical distribution of students at FChT by regions.



Number of students at FChT by regions (as of 31 October 2021)

2.3 Newly Admitted Students

In 2021, the faculty was active in attracting secondary school students. The faculty addressed the potential applicants at various events, in the radio, press, internet (higher education exhibitions Gaudeamus in Brno and Prague, Open Days, Chemical Olympiad, Science and technology festival AMAVET, Chemistry Race competition, advertisements in press, promotion through the radio, information on websites and social networks, presentations in secondary schools, etc.).

Due to the government decisions responding to the coronavirus pandemic, a number of traditional events aimed at searching for talented students and applicants were held online using modern technology.

Open Days

On 27 January 2021, the first Online Open Day was held. A total of 107 secondary school students joined the event virtually (49 students from grammar schools and 58 students from other secondary schools). The Vice-Dean provided the applicants with the basic information about the study, study programmes and fields of study offered by the faculty and about the conditions of the admission procedure and opportunities for international study under the ERASMUS+ Programme. After the joint session, students had the opportunity to discuss with teachers of the different study programmes.

The second Open Day took place on 10 February 2021. This Open Day was joined by 26 students from grammar schools and 41 students from other secondary schools.

Search for talented students

The faculty has in place a long-term programme aimed at searching for talented students and secondary school applicants. In 2021, FChT supported the regional round of the **Festival of science and technology for children and youth in the Pardubice Region called AMAVET** by awarding the best achievements in chemistry, biology and ecology and promises of scholarship for the award-winning secondary school students. The regional round of the competition took place on 12 and 14 May 2021 online. The award ceremony took place on 10 June 2021 at the Faculty of Chemical Technology. The awards were presented by the Dean Prof. Ing. Petr Kalenda, CSc. The aim and mission of the AMAVET festival is to encourage talented elementary school children and especially secondary school students to discover and develop their creative skills through specific scientific and technical projects. FChT has in place a long-term programme focused on identifying and acquiring these talented students for study of chemistry at FChT.

The Dean's award in the secondary school student category was presented to:

1st place

Tereza Jaklová
Gymnázium A. Jiráska, Litomyšl

2nd place

Klára Hegrová
Gymnázium A. Jiráska, Litomyšl

Matyáš Dezort
Gymnázium A. Jiráska, Litomyšl

3rd place

Nicole Oyelakin, Natálie Šejnorová, Sára Teran
Gymnázium a Letecká SOŠ Moravská Třebová

Aneta Dvořáková, Eva Šurýnová

Gymnázium Vysoké Mýto

Anastázie Skučková
Gymnázium A. Jiráska, Litomyšl

The Dean's award in the junior category was presented to:

Sára Hummelová, Veronika Vaňková
ZŠ Pardubice – Polabiny, Npor. Eliáše

Viktorie Linda Švejdová
ZŠ Chrudim, Dr. Jana Malíka

Aleš Kolman
ZŠ Vítějeves

Helena Nimshausová
Gymnázium A. Jiráska, Litomyšl

Barbora Bendová
Gymnázium A. Jiráska, Litomyšl

Another important promotional event organized by the faculty aimed at attracting talented students for study at FChT is the regional round of the **Chemical Olympiad.** The Chemical Olympiad is a traditional competition for grammar school students who in addition to curricular chemistry want to improve in the field that they want to study after graduation from secondary school. On 3 December 2021, the regional round of A category took place (last years of grammar schools) for the Pardubice and Hradec Králové Regions involving 14 competitors in a new format 3 lessons of theory + 3 lessons of practice. The best results were achieved by Tomáš Heger from Jiráskovo gymnázium Náchod (84.05 %).

In 2021, the faculty supported the sixth year of the chemical competition **Chemistry Race.** This is a one-day competition for 3 to 5-member teams of secondary school students interested in chemistry. The competition was divided into two categories – category B for younger contestants (secondary school students in grades 1 and 2) and the top category A for secondary school students from all grades. The teams solve a set of theoretical tasks during a specific time period. The team that resolves the highest number of tasks during two hours is the winner. The competition took place online on 5 February 2021. A total of 39 teams competed in category A and 30 teams in category B. The winner in category A was the team of students from Gymnázium Jana Keplera, Prague 6 (Zuckor team), while the team of students from Gymnázium Křenová, Brno (Mladí Křeni) was the winner in category B. The winning teams received awards from the Dean including presents and scholarship, which will be granted if they enrol for study at the faculty.

The faculty traditionally supports **Students' Professional Activities (SPA)**. Academic staff and postgraduate students from the Faculty are actively involved in scientific training of secondary school students who work on their competition projects. In this way, young researchers are involved in scientific activities. The interest of secondary school students in developing their projects at FChT is increasing. Last year, the national round and most qualification rounds took place using modern technology. Despite the restrictions and changes, the extent of the competition was almost identical with previous years. Although students did not have the opportunity to consult their work in person, they tried out different forms of online communication.

The Faculty of Chemical Technology together with other faculties of the University of Pardubice regularly organize an educational scientific road-show called **University in Motion**. For several years, employees and students of the faculty have visited school yards with an extremely popular event. Students are involved in experiential workshops, the purpose of which is to show the world of modern technology and present technical and scientific disciplines in a playful and entertaining form and encourage or

improve the interest of young people in technical and scientific disciplines. In 2021, employees of the faculty visited grammar schools in Čáslav, Litomyšl, Přelouč and Česká Třebová.

Instead of the traditional Science and technology fair at Pernštýnské Square in the historical centre of Pardubice, members of the faculty visited **summer and day camps** around Pardubice with a popular-scientific programme. The purpose of these events was to raise children's enthusiasm for chemistry, science and technology.

In the week from 16 August to 20 August 2021, children from Pardubice and its surroundings became university students and by means of **Day Camps** participated in a special holiday programme at selected faculties of the University of Pardubice. The Faculty of Chemical Technology prepared an interesting and entertaining programme. Children had the opportunity to experience the atmosphere of the laboratories, lecture rooms, try out the work of scientists and experts and learn about a number of interesting tasks and experiments.

The Faculty of Chemical Technology is a traditional participant in the higher education and lifelong learning fair **Gaudeamus** in Prague (19–21 January 2021) and in Brno (23–26 November 2021). The purpose of the fairs is to provide the maximum possible amount of information about university education to students and graduates from secondary schools, higher vocational schools, students and graduates from bachelor's degree programmes and those who are interested in lifelong learning.

The fair in Prague took place online. The organizers prepared a series of online presentation days the purpose of which was to inform secondary school students about the university and faculty and about study opportunities after graduation from secondary school.

During the November fair in Brno, the university stand was attended by thousands of secondary school students including their teachers, educational counsellors and representatives of other universities. The representatives of the faculty at the University of Pardubice stand provided detailed information about the study and admission exams and handed out a number of printed materials relating to the study. In addition to providing information about the study, the university had several interactive stands.

In 2021, the faculty supported the 14th year of **Search for the Best Young Chemist** and is the traditional sponsor of this event. As in previous years, the competition took place in four categories. The best young chemist was the one with the best results in the online test part. The second category was the project part, which was intended for the whole classes. The task for the competitors was to develop a project according to the instructions given by the High School of Chemistry Pardubice. The next category was the best elementary school with the most successful young chemists. The last category was the best chemistry teacher. This was the teacher whose students achieved the best results in the test part. The organizer of the competition "Search for the Best Young Chemist" is the High School of Chemistry Pardubice and the Pardubice Region. The general partner of the competition is the Faculty of Chemical Technology, University of Pardubice. Unfortunately, the award ceremony could not take place due to the coronavirus pandemic. Therefore, the prizes were awarded individually under strict hygienic conditions in the premises of Czech Marketing Agency who is the traditional organizer.

In 2021, the **9th year of the national finals of the competition Search for the Best Young Chemist of CR** was held (15 June 2021). The national finals of this biggest chemical competition took place online. The online test was completed by 38 most successful students who advanced from the regional rounds. Although the competition was affected by the pandemic, almost 10,000 students from grade eight and nine took place, which confirms the interest of the young generation not only in the competition but also in chemistry as a promising field of study. The national finals took place online and was broadcast on YouTube. The award ceremony was broadcast online and was attended by the organizers and the announcers of the national finals.
The Dean of FChT awarded the best five young chemists with scholarships,+ which they will be granted if they enrol for study at the faculty.

The Dean's award in the **national finals of the competition Search for the Best Young Chemist of CR** was presented to the competitors in the 1st to 5th place.

1st place
Jan Najbert, ZŠ Slovanské náměstí, Brno

2nd place
Marek Kroviář, ZŠ Vratimov

3rd place
Kateřina Amálie Rumpíková, ZŠ Luhačovice

4th place
Ondřej Kameník, ZŠ a MŠ Červený vrch, Vokovice

5th place
Tomáš Holub, ZŠ Tišnov, náměstí 28. října

Regarding the fact that students' success is largely affected by those who teach them, the teachers of the first three students were awarded as well: Hana Hamplová from ZŠ Slovanské náměstí Brno, Jitka Hajdušková from ZŠ Vratimov and Dana Čuříková from ZŠ Luhačovice.

In 2021, the faculty was again the partner of **Children's Super Day** which was held on 18 September 2021 at the Pardubice racecourse. The employees of the faculty prepared a varied and interesting programme with demonstrations of chemical magic.

In 2021, **the Researchers' Night** (24 September 2021) was again a personal meeting of scientists and thousands of science fans directly at the university. The visitors enjoyed demonstrations of chemical and physical experiments. The Researchers' Night is one of the biggest Europe-wide projects the purpose of which is to present science and scientific issues to the general public.

The University of Pardubice again enriched the programme of the Sports Park Pardubice (7–15 August 2021). The visitors enjoyed a special popular educational programme with attractive and interactive scientific and technical demonstrations. At the experiential **SCIENCE POINT**, young scientists and students showed the visitors the world of modern science and through playful and educative demonstrations presented various world curiosities and gave the visitors chemical quizzes.

Students' scientific professional activities at the Faculty of Chemical Technology

Students' scientific professional activities (SSPA) are intended for students in bachelor's and follow-up master's degree programmes at the Faculty of Chemical Technology, the purpose of which is to engage students in research and scientific activities beyond the scope of their study. SSPA is a significant form of students' preparation through which they learn to present the results of their work, develop scientific and professional skills and improve their argumentation abilities, presentation skills and scientific writing.

Due to the emergency measures related to the coronavirus pandemic, this activity did not take place in the academic year 2020/2021.

Admission Procedure

The admission procedure for study in bachelor's degree programmes for the academic year 2021/2022 took place in two rounds. The application submission date for the study programmes was 31 March 2021. The deadline was then postponed to 30 June 2021.

Regarding the fact that during the first round of the admission procedure the capacity of some bachelor's degree programmes was not achieved, the second round was announced with the application submission date 12 August 2021. The second round of the admission procedure was based on the

evaluation of the applicants' academic achievement in secondary school – the applicants were ranked in order and admitted for study according to available capacity of relevant study programmes.

The application submission date for the follow-up master's degree programmes was 31 July 2021. The admission procedure took place on 1 and 2 September 2021. The admission exam was carried out by means of an oral interview or written test with the applicants. The application submission date for the doctoral degree programmes was 30 April 2021. The admission exam was carried out by means of an oral interview on 8 June 2021. The deadline for the submission of applications in the second round was 30 June 2021 and the admission procedure took place in September 2021. The results of the admission procedure are summarized in the following table.

Full-time form of study – bachelor's degree programmes

Study Programme	Number of applicants	Accepted 1st round	Accepted 2nd round	Total accepted	Enrolled
Special chemical and biological programmes – laboratory assistant	350	216	21	237	**152**
Graphic arts and printing technology*	60	37	4	41	**27**
Pharmacochemistry and medicinal materials*	187	106	7	113	**66**
Surface protection of building and construction materials*	24	13	4	17	**13**
Economy and management of chemical industry enterprises*	50	15	7	22	**16**
Analysis of biological materials*	116	56	12	68	**32**
Chemistry and technology of environment protection*	45	24	1	25	**14**
Polymeric materials and composites*	17	5	3	8	**5**
Chemistry*	120	58	11	69	**42**
Evaluation and analysis of foodstuffs*	99	57	6	63	**37**
Inorganic and bioinorganic materials	27	9	2	11	**8**
Total	**1095**	**596**	**78**	**674**	**412**

* Newly accredited programmes

Full-time form of study – follow-up master's degree programmes

Study Programme	Number of applicants	Accepted without admission exam	Accepted with admission exam	Total accepted	Enrolled
Chemistry and technology of materials	19	18	-	18	16
Analysis of biological materials*	32	21	3	24	9
Graphic arts and printing technology*	6	-	4	4	4
Economy and management of chemical industry enterprises*	13	-	11	11	10
Bioanalytical laboratory diagnostics in medicine*	47	-	28	28	25
Engineering of energetic materials*, e)	1	-	-	-	-
Engineering of energetic materials*	9	-	5	5	5
Analytical chemistry*	20	-	16	16	15
Inorganic and bioinorganic chemistry*	8	6	4	4	2
Evaluation and analysis of foodstuffs*	28	-	25	25	21
Material engineering*	5	5	-	5	5
Physical chemistry*	4	-	4	4	2

Chemical and process engineering	Chemical engineering*	3	1	-	1	0
	Environment protection*	4	4	-	4	3
Sustainable development in chemistry and technology*		6	4	2	6	5
Inorganic technology*		4	4	-	4	3
Materials chemistry*, e)		2	-	-	-	-
Organic chemistry and technology	Organic chemistry*	12	-	11	11	10
	Technology of organic specialities	3	-	2	2	1
Total		**226**	**63**	**115**	**172**	**136**

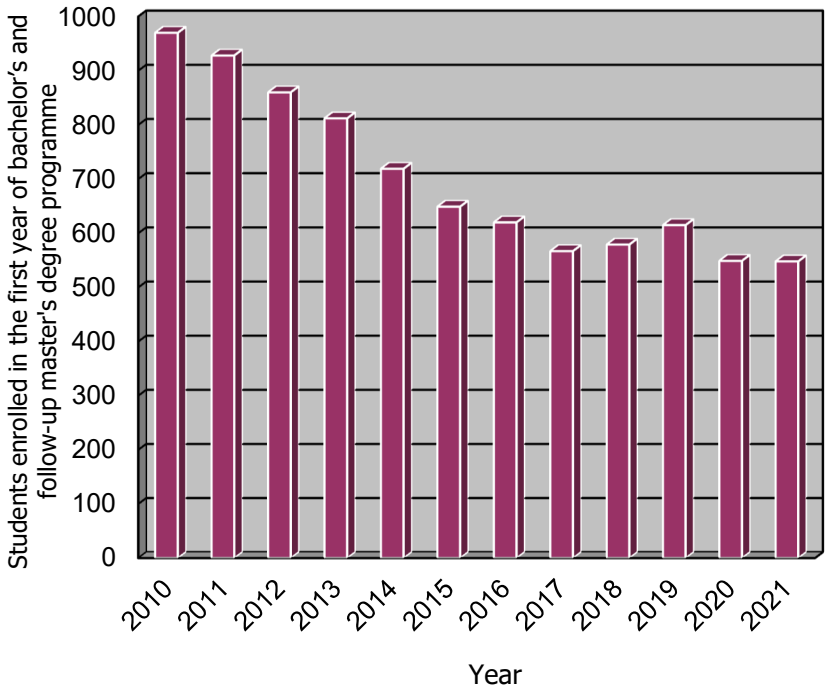
* Newly accredited programmes

e) Teaching in English

Trend in the number of newly enrolled students in the first year of bachelor's and follow-up master's degree programmes

Year	**2010/11**	**2011/12**	**2012/13**	**2013/14**	**2014/15**	**2015/16**
Applicants	1888+58c	1829+50c	1674+66c	1610+72c	1466+91c	1317+121c
Accepted	1174+11c	1284+29c	1245+49c	1176+55c	1115+64c	1005+89c
Newly enrolled	**938+32c**	**910+18c**	**830+30c**	**777+35c**	**682+37c**	**601+48c**

Year	**2016/17**	**2017/18**	**2018/19**	**2019/20**	**2020/21**	**2021/22**
Applicants	1262+164c	1151+132c	1107+149c	1233+177c	1128+184c	1082+239c
Accepted	916+116c	858+89c	838+110c	898+124c	770+103c	736+110c
Newly enrolled	**563+57c**	**516+51c**	**521+58c**	**550+65c**	**493+56c**	**492+56c**



Trend in the number of newly enrolled students in the first year of bachelor's and follow-up master's degree programme between 2010 and *2021*

Registered and newly enrolled students in full-time doctoral degree programmes

Study Programme	Number of applicants	Total accepted	Enrolled
Chemistry and technology of materials	4	2	2
Chemistry and Technology of Materials[e)]	1	1	-
Analytical chemistry*	4	4	4
Inorganic chemistry*	1	1	1
Inorganic Chemistry*, [e)]	1	1	-
Chemistry and technology of inorganic materials*	4	3	3
Organic chemistry*	3	3	3
Physical chemistry*	3	3	3
Engineering of energetic materials*	3	3	3
Physical Chemistry*, [e)]	3	2	-
Inorganic technology*	1	1	1
Chemical and process engineering*	3	2	2
Organic technology*	1	1	1
Analytical chemistry*, [e)]	2	2	2
Chemistry and technology of inorganic materials*, [e)]	2	2	2
Chemical and process engineering*, [e)]	2	1	1
Biochemistry*	1	-	-
Economics and management of businesses with process manufacturing operations*	4	4	4
Total	**43**	**36**	**32**

* Newly accredited programme

[e)] Teaching in English

Registered and newly enrolled students in part-time doctoral degree programmes

Study Programme	Number of applicants	Total accepted	Enrolled
Chemistry and technology of materials	1	1	1
Total	**1**	**1**	**1**

695 applicants were admitted in full-time bachelor's degree programmes. 178 applicants (in total 873) were admitted in follow-up master's degree programmes. A total of 32 students were admitted in both full-time and part-time doctoral degree programmes. **In the academic year 2020/2021, a total of 905 students were admitted of whom 576 enrolled for study.**

Preparatory courses

Before the beginning of regular classes in the winter semester of the first year of bachelor's degree, the Department of General and Inorganic Chemistry regularly holds the "General and inorganic chemistry" course. The course focuses on acquiring and maintaining the basic chemical skills, such as the chemical nomenclature, solution of chemical equations, amount of substances and the preparation of solutions with a defined concentration. In view of the potential health risks associated with the Covid-19 pandemic, this course was not held in the academic year 2021/22. However, students were provided with online support.

2.4 Numbers of Graduates in Bachelor's, Master's and Doctoral Degree Programmes

Numbers of graduates by type of study in previous years

Type of study	2010	2011	2012	2013	2014	2015
Bc.	191	243	250	260	223	209
Mgr.	35	34	47	36	30	38
Ing.	104	103	106	114	149	146
Ph.D.	41	17	21	29	29	27
Total	**371**	**397**	**424**	**439**	**431**	**420**

Type of study	2016	2017	2018	2019	2020	2021
Bc.	232	208	176	172	163	172
Mgr.	23	24	43	36	26	31
Ing.	116	98	121	89	96	81
Ph.D.	19	26	32	29	28	17
Total	**390**	**356**	**372**	**326**	**313**	**301**

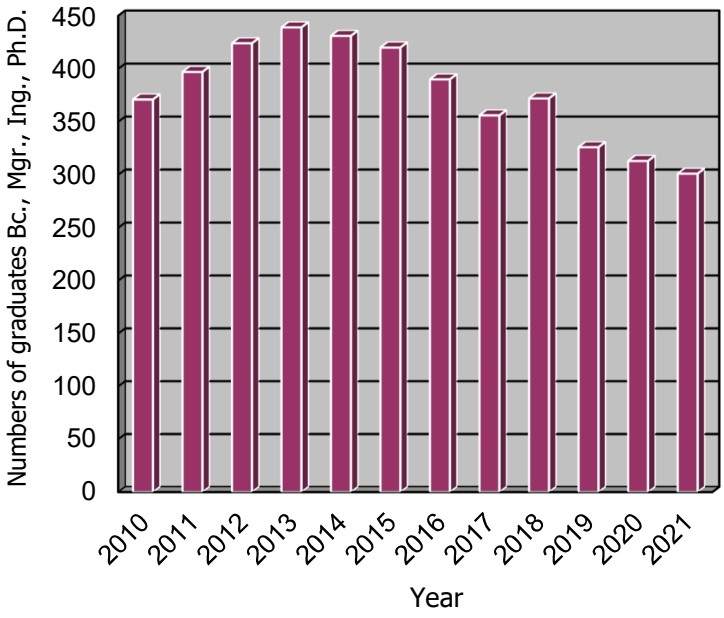
The numbers in the table correspond with the V 12-01 Statement for 1 January to 31 December of the relevant year

Numbers of graduates in doctoral degree programmes by year

Doctoral degree graduates	2010	2011	2012	2013	2014	2015
Number	37	22	23	26	24	31

Doctoral degree graduates	2016	2017	2018	2019	2020	2021
Number	20	23	35	29	31	13

The numbers of graduates are specified for the period from 1 November to 31 October of the relevant year

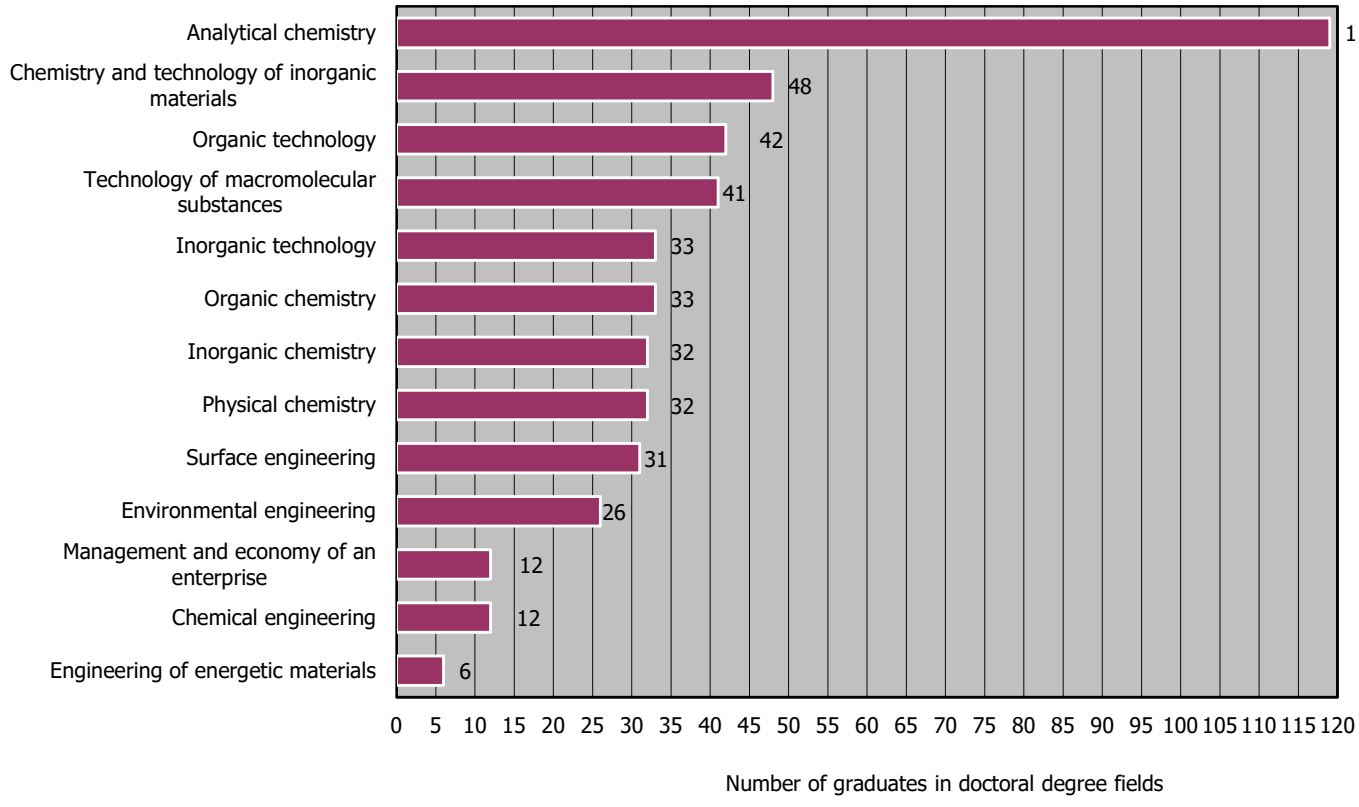


Numbers of graduates Bc., Mgr., Ing. and Ph.D. between 2010 and 2021

Graduates in doctoral degree programmes in the period from 1 November to 31 October of the following year

Study Programme	Number of graduates				
	2016/2017	2017/18	2018/19	2019/20	2020/21
Inorganic chemistry	3	1	3	1	1
Organic chemistry	4	2	2	4	1
Analytical chemistry	5	9	3	10	4
Physical chemistry	2	1	3	2	-
Chemistry and chemical technology	3	-	3	4	-
Chemical and process engineering	1	9	7	4	1
Chemistry and technology of materials	5	13	8	6	6
Total	**23**	**35**	**29**	**31**	**13**

The research projects of the departments and institutes also involved a number of postgraduate students because the topics of their dissertations were based on the issues addressed at these departments and institutes. Postgraduate students were included in research teams and actively contributed to the scientific and research results of the faculty. Between 2005 and 2021, a total of 467 postgraduate students defended their dissertations on issues closely related to the issued addressed at the departments and institutes of the faculty. The following figure shows in which doctoral degree programmes and fields of study the dissertations were defended.



Overview of doctoral degree fields and number of dissertations between 2005 and 2021 corresponding with the scientific and research focus of FChT departments and institutes

Award-winning papers of FChT students

In 2021, a number of dissertations, master's theses and bachelor's theses were awarded for their outstanding theoretical and experimental level.

Award of the Dean of the Faculty of Chemical Technology, University of Pardubice for outstanding dissertation awarded in the academic year 2020/2021

Ing. Michaela Fecková, Ph.D.
Organic and organometallic heterocyclic luminescent materials: towards OLED applications
Supervisor: prof. Ing. Filip Bureš, Ph.D.
Institute of Organic Chemistry and Technology

Level 1 Award of the Rector for master's thesis defended in 2021

Ing. Marcela Chrtková
Study of condensation of benzene-1,3,5-triacetonitrile with aromatic (di)carbaldehydes
Supervisor: Ing. Patrik Pařík, Ph.D.
Institute of Organic Chemistry and Technology

Level 2 Award of the Rector for master's thesis defended in 2021

Ing. Denisa Kolářová
Determination of selected classes of sphingolipids in human plasma by mass spectrometry
Supervisor: Ing. Robert Jirásko, Ph.D.
Department of Analytical Chemistry

Ing. Petr Kuna
Modification of ballistic properties of pyrotechnic compositions
Supervisor: Ing. Vojtěch Pelikán, Ph.D.
Institute of Energetic Materials.

Mgr. Lucie Šacherlová
Study of antitumor effect of selected organometallic molybdenum complexes on human leukemia cells MOLT-4
Supervisor: Prof. Ing. Jaromír Vinklárek, Dr.
Department of General and Inorganic Chemistry

Award of the Dean of the Faculty of Chemical Technology, University of Pardubice for outstanding level and defence of master's thesis

Ing. Martina Žabenská
The synthesis and characterization of selected DA hexaarylbenzenes
Supervisor: Doc. Ing. Petr Šimůnek, Ph.D.
Institute of Organic Chemistry and Technology

Mgr. Daniela Nováčková
The potential of 3D printing for suppression of alcohol-induced dose dumping effect of matrix tablets containing tramadol hydrochloride
Supervisor: Doc. Ing. Alena Komersová, Ph.D.
Department of Physical Chemistry

Ing. Leona Hofmeisterová
Methods for identification of "Arcobacter-like" microorganisms
Supervisor: Ing. David Šilha, Ph.D.
Department of Biological and Biochemical Sciences

Ing. David Rubeš
Preparation of unsaturated polyester resins with decreased flammability
Supervisor: Ing. Miroslav Večeřa, CSc.
Institute of Chemistry and Technology of Macromolecular Materials

Ing. Ondřej Černík
Determination of an alternative toxicological in vitro eye irritation test by HET-CAM method
Supervisor: Prof. Ing. Jaromíra Chýlková, CSc.
Institute of Environmental and Chemical Engineering

Ing. Anna Mausová
Synthesis and basic luminescence characterization of substituted diphenylamino diphenyl stilbenes
Supervisor: Doc. Ing. Aleš Imramovský, Ph.D.
Institute of Organic Chemistry and Technology

Ing. Ondřej Moždiak
Synthesis and reactivity of η^6 - coordinated Ru(II) complexes
Supervisor: Prof. Ing. Roman Jambor, Ph.D.
Department of General and Inorganic Chemistry

Ing. Jiří Fejk
Pigments of $SrTiO_3$ type doped with cobalt ions
Supervisor: Doc. Ing. Žaneta Dohnalová, Ph.D.
Department of Inorganic Technology

Ing. Štěpán Voneš
Iron(III) complex with pentadentate phthalocyanine based ligand as drier for alkyd resins
Supervisor: Ing. Jan Honzíček, Ph.D.
Institute of Chemistry and Technology of Macromolecular Materials

Ing. Michaela Houdková
Spectral evaluation of selected samples in angular dependence
Supervisor: Doc. RNDr. Petr Janíček, Ph.D.
Institute of Applied Physics and Mathematics

Czech Glass Society Award for the best master's thesis defended in 2021 in the area of glass and amorphous materials

Ing. Tomáš Hostinský
Lithium phosphate glasses modified with transition metal oxides
Supervisor: Ing. Petr Kalenda, Ph.D.
Department of General and Inorganic Chemistry

Pfizer, spol. s r.o. Award for the best master's thesis defended in 2021 in the area of pharmacochemistry

Ing. Jana Macháčková
Matrix tablets coated by 3D printing method
Supervisor: Ing. Václav Lochař, Ph.D.
Department of Physical Chemistry

Mgr. Anna Runčíková
The determination of asymmetric dimethylarginine in human plasma
Supervisor: Mgr. Pavla Žáková, Ph.D.
Department of Biological and Biochemical Sciences

Award of Devro, s.r.o., for the best dissertation in the area of chemistry and biochemistry in 2021

Ing. Monika Vokálová
Effect of water pH on the quality of lavender oil obtained by hydrodistillation
Supervisor: Ing. Tomáš Bajer, Ph.D.
Department of Analytical Chemistry

Ing. Dominika Josefová
Gadolinium of anthropogenic origin in crops intended for food purposes
Supervisor: Doc. Ing. Anna Krejčová, Ph.D.
Institute of Environmental and Chemical Engineering

Ing. Tereza Hloušková
Chemical and physical properties of linden syrup
Supervisor: Doc. Ing. Libor Červenka, Ph.D.
Department of Analytical Chemistry

Synthesia, a.s. CEO Award for the most interesting content of master's thesis defended in 2021 *in the area of organic pigments and technologies, processes, materials and technologies with a significant impact on industrial production*

Ing. Tereza Frenclová
Determination of 2,2',5,5'-tetrachlorobiphenyl (Congener 52) in organic colorants
Supervisor: Doc. Ing. Jan Fischer, CSc.
Department of Analytical Chemistry

Ing. Pavel Matějíček
Utilization of the coaction of carbonaceous sorbents and ionic liquids for the removal of non-biodegradable flufenamic acid from contaminated aqueous solutions
Supervisor: Doc. Ing. Tomáš Weidlich, Ph.D.
Institute of Environmental and Chemical Engineering

Miroslav Jureček Foundation Award for the best master's thesis in the academic year 2020/21

1st place

Mgr. Iva Vykydalová
Quantification of protein samples using mass spectrometry and stable isotope labeling
Supervisor: Mgr. Rudolf Kupčík, Ph.D.
Department of Biological and Biochemical Sciences

2nd place

Ing. Tereza Korábková
Acidity of the reaction medium as a factor controlling the regioselectivity of C-H functionalization reactions
Supervisor: Ing. Jiří Váňa, Ph.D.
Institute of Organic Chemistry and Technology

3rd place

Ing. Jana Kubáleková
Use of supercritical fluid extraction for extraction of polar and non-polar substances from nuts
Supervisor: Doc. Ing. Petra Bajerová, Ph.D.
Department of Analytical Chemistry

Award of the Dean of the Faculty of Chemical Technology, University of Pardubice for outstanding level and defence of bachelor's thesis

Bc. Michal Duchoslav
Technical acceptance testing for sheet-fed offset printing presses – methodology for evaluation of streaking
Supervisor: Ing. Jan Vališ, Ph.D.
Department of Graphic Arts and Photophysics

Bc. Aneta Dvorníková
Varicose veins of the lower limbs as one of the manifestations of chronic venous disease
Supervisor: Mgr. Katarína Svrčková, Ph.D.
Department of Biological and Biochemical Sciences

Bc. Štěpán Jirman
Visualization using schlieren techniques
Supervisor: Doc. Ing. Jiří Pachman, Ph.D.
Institute of Energetic Materials.

Bc. Kateřina Matelová
Biodegradation of drugs by microorganisms
Supervisor: Ing. Jaroslava Kořínková, Dr.
Institute of Environmental and Chemical Engineering

Bc. Sára Nováková
Duchenne muscular dystrophy
Supervisor: Mgr. Šárka Štěpánková, Ph.D.
Department of Biological and Biochemical Sciences

Bc. Viktor Peprník
Polymer composites in construction
Supervisor: Ing. Miroslav Večeřa, CSc.
Institute of Chemistry and Technology of Macromolecular Materials

Bc. Daniel Pokorný
Cyclic silylselenides as precursors for atomic layer deposition
Supervisor: Prof. Ing. Filip Bureš, Ph.D.
Institute of Organic Chemistry and Technology

Bc. Eva Prokopová
Heterocyclic 1,2 dicarbonyl compounds: synthesis and biological significance
Supervisor: Prof. Ing. Filip Bureš, Ph.D.
Institute of Organic Chemistry and Technology

Bc. Eliška Trnková
Food intolerance
Supervisor: Doc. Ing. Martin Adam, Ph.D.
Department of Analytical Chemistry.

Bc. Tereza Vrbická
The relationship between servitization and sustainable development in the chemical industry
Supervisor: Ing. Vladimíra Vlčková, Ph.D.
Department of Economy and Management of Chemical and Food Industry

Pfizer ČR, spol. s r.o. Award for outstanding bachelor's thesis defended in 2021

Bc. Pavlína Konopáčová
Study of swelling of polymeric films from water insoluble derivatives of hyaluronan

Supervisor: Doc. Ing. Alena Komersová, Ph.D.
Department of Physical Chemistry

Bc. Petr Pospíšil
Preparation of stereoisomers of 1-deoxysphingosine derivatives
Supervisor: Doc. Ing. Pavel Drabina, Ph.D.
Institute of Organic Chemistry and Technology

Awarded students other than from FChT in 2021

Bc. Lenka Gondová
Effect of lanthanum nanoparticles on the properties and corrosion resistance of latex binders
Josef Korita Foundation Award for the best poster in bachelor's and master's degree programmes awarded at the 24th ACE Conference in Tábor held on 20–21 October 2021.
Supervisor: Prof. Ing. Andréa Kalendová, Dr.
Institute of Chemistry and Technology of Macromolecular Materials

Ing. Jan Hroch
Preparation of brown cool pigments with perovskite structure of $SrSnO_3$
The best students' presentation at the 6th Conference on Modern Trends in Inorganic Technology, 1–4 September 2021, Košice.
Supervisor: Doc. Ing. Žaneta Dohnalová, Ph.D.
Department of Inorganic Technology

Mgr. Ing. Jakub Idkowiak
Changes in sphingomyelin and sulfatide profiles of plasma, urine, and tissue samples observed in patients with kidney cancer
Best Poster Award at the 22nd School of Mass Spectrometry, Srní, 5–10 September 2021.
Supervisor: prof. Ing. Michal Holčapek, Ph.D.
Department of Analytical Chemistry

Ing. Barbora Kamenická
Adsorption of anti-inflammatory drugs on carbonaceous sorbents
Scientific Committee Award for presentation at the Membranes and Membrane Processes Workshop, 24 November 2021, Stráž pod Ralskem.
Supervisor: Doc. Ing. Tomáš Weidlich, Ph.D.
Institute of Environmental and Chemical Engineering

Bc. Pavel Matějíček
Utilization of the coaction of carbonaceous sorbents and ionic liquids for the removal of non-biodegradable flufenamic acid from contaminated aqueous solutions
Award for the first place in the 2021 Karel Velek Competition for exceptionally precise and thematically innovative master's theses in the field of waste management.
Supervisor: Doc. Ing. Tomáš Weidlich, Ph.D.
Institute of Environmental and Chemical Engineering

Bc. Marek Šenfeldr
Pigmented organic coatings designed to protect structural steel
Josef Korita Foundation Award for the best poster in bachelor's and master's degree programmes awarded at the 24th ACE Conference in Tábor held on 20–21 October 2021
Supervisor: Ing. Miroslav Kohl, Ph.D.
Institute of Chemistry and Technology of Macromolecular Materials
Ing. Edvin Wallace
The use of nanofiltration for separation of heavy metals from wastewater
Komerční banka Award for outstanding master's thesis defended in 2021.
Supervisor: prof. Ing. Petr Mikulášek, CSc.
Institute of Environmental and Chemical Engineering

2.5 Credit System

The principles of the credit system correspond with the international ECTS system. The use of the credit system for the evaluation of academic achievement at the faculty is defined by the "Study and Examination Code of the University of Pardubice".

2.6 Lifelong Learning

The licence study **Rock disintegration by explosion** is intended for further education and retraining of employees in the area of explosion techniques. Based on decision ČBÚ 3501/II/08 as of 16 January 2009, the learning content and texts of the licence study are approved as preparation courses for blasting technical managers before a qualification exam. This qualification exam can also be taken by licence study participants who meet other conditions for obtaining the blasting technical manager qualification.

The licence study **Modern technology in graphic arts and printing technology** is intended for further education and retraining of employees who work in the printing industry, are involved in trading of printing products or are suppliers of raw materials for the printing industry. The course participants will gain a broad range of knowledge in all areas of printing production and applications of printing techniques, printing materials and state-of-the-art technologies, quality assessment procedures and the requirements of the applicable ISO standards for printing production.

The licence study **The basic technological principled of the production of fibres, paper, paperboard and their processing** is intended for further education and retraining of employees with a university degree who work in the cellulose-paper processing industry, are involved in trading paper products or are suppliers of raw materials and equipment for the cellulose and paper industry. The purpose of the licence study is to present the basic theoretical principles of the production technology of fibres, paper and paperboard, including ecological aspects and processing aspects.

The licence study **Theory and technology of explosives** is intended for further education and retraining of employees in explosives, ammunition, processing and delaboration plants, including employees who use, store or trade explosives and explosion hazardous substances. This study provides the basic information about the protection of various structures from explosion of gases, vapours or flammable dust dispersions (chemical and food-processing plants, power engineering, etc.). The study also includes the issue of testing and special analyses of explosives, lectures on the fundamentals of ballistics and designing of ammunition and weapons.

Lifelong learning courses at FChT in 2021

Name of lifelong study programme	Number of participants	Length of study	Form of study	Number of sessions
Commenced in 2021				
Theory and technology of explosives – organized by ÚEnM	8	4 semesters	Licence	345
Ongoing				
The basic technological principles of the production of fibres, paper, paperboard and their processing - organized by ÚChTML	21	3 semesters	Licence	200
Rock disintegration by explosion - organized by ÚEnM	9	4 semesters	Licence	400
Modern technology in graphic arts and printing technology - organized by KPF	10	2 semesters	Licence	224
Theory and technology of explosives – organized by ÚEnM	11	4 semesters	Licence	345

2.7 University Textbooks and Monographs Issued at FChT in 2021

An integral part of educational activity is the preparation of study materials – university textbooks and monographs. In 2021, the following publications were issued at FChT:

University textbooks

1. Svoboda L., Kalendová P.: Agrochemistry I. Physiology of Plants, 1st ed., 116 copies, 196 pages, CD-ROM.
2. Drašar Č.: Physics I, 1st edition, 311 copies, 172 pages.
3. Handlíř K., Nádvorník M., Vinklárek J., Vlček M.: Laboratory exercises in general and inorganic chemistry II., 3rd ed., 421 copies, 138 pages.
4. Handlíř K., Nádvorník M., Vlček M.: Calculations and exercises in general and inorganic chemistry I, 11th ed., 415 copies, 180 pages.
5. Kašparová J., Pavlišta M.: Mathematics, 1st ed., 313 copies, 130 pages.
6. Šimůnek P., Váňa J.: Collection of tasks in organic structural analysis, 3rd ed., 165 copies, 266 pages.

In total 1,625 copies, 116 CD-ROM copies and 1,082 pages of text.

Monographs

1. Franc A.: Guide for the development and application of the dissolution method with respect to oral immediate release medicinal products, 1st ed., 200 copies, 68 pages.
2. Košťálová J., Bednaříková M., Jelínková M., Munzarová S., Paták M.: Diversity Management, 1st ed., 66 copies, 150 pages.

In total 266 copies and 218 pages of text.

3. Research and Development

3.1 Scientific and Research Focus of Departments and Institutes

The scientific and research activity of the faculty focuses primarily on high-quality basic and applied research in accordance with the amended version of the Strategic Plan of the Faculty of Chemical Technology, University of Pardubice for the period from 2021.

Research, experimental development and innovations (referred to as "RDI") is based on specific chemical sciences and fields that the faculty has developed in the long term and in which the faculty has achieved significant outcomes in the national as well as international context. FChT focuses on RDI in the following fields: FORD 1 Natural Sciences, 2 Engineering and Technology and 3 Medical and Health Sciences.

The scientific and research activities are performed by working groups established at the faculty's departments and institutes, which are actively involved in projects supported especially by the Czech Science Foundation, Technology Agency of the Czech Republic or departmental support providers. An important aspect in the development of scientific and research activities of the faculty are the resources acquired as a result of collaboration with industrial entities and as a result of international cooperation. This is also related to the extensive publication activity including papers in scientific impacted periodicals, monographs, patents, etc. In terms of finance, the amount of creative activity focusing on science, research and innovations represented a significant part of FChT's budget in 2021.

Dominant focus of FChT in basic and applied research:

- Inorganic pigments for ceramics and paints,
- Analyses and separations of bio-analytical and food compounds,
- Analyses of diagnostically relevant substances for the study of metabolism and oxidative stress in patients with various types of diseases,
- Biologically active compounds for human and veterinary medicine applications,
- Detection of microorganisms by culturing and molecular biological methods,
- Electrochemistry, interphase chemistry and methods of preparation and subsequent element analysis of samples with a focus on the development and application of separation, analytical, detection and diagnostic techniques, instrumentation and sensors in the area of human protection, environmental protection and material analysis,
- Energetic materials for applications in the automotive, aerospace, mining, construction and defence sectors,
- Photonics, optics and optoelectronics,
- Environmental processes (e.g. technologies in pre-treatment and treatment of process, waste and municipal water),
- Chemical processes with high added value; this particularly applies to the research of new and highly selective adsorbents, catalysts (homogeneous and heterogeneous catalysis) and photocatalysts,
- Identification/detection of biomarkers in patients with neurodegenerative and neoplastic diseases, including early detection of cancer,
- Volume glass and amorphous thin layers,
- Organic dyes for colouring and printing,
- Organic materials for optoelectronics,
- Organic pigments for the automotive industry and construction,
- Organic coatings and paints,
- Organometallic and coordination compounds with subsequent applications in catalytic processes as precursors of advanced materials or compounds with biological effects,
- Advanced low-dimensional nanomaterials (nanoparticles, nanotubes, nanofibres, nanofilms) using modern synthesis methods including applications (e.g. batteries, catalysts, water degradation, solar cells, etc.),
- Nanobiomedical technologies,
- Semiconductors and materials for thermoelectric applications,

- Polymeric materials, fibres, composites and organic coatings,
- Material printing,
- Membrane separation processes,
- Safety engineering methods and risk analyses in the chemical industry,
- Glass producing materials (amorphous/crystalline form, bulk materials/thin layers), advanced viscous and kinetic phenomena and physical-chemical processes associated with the use of these materials,
- Determination of the sensitivity of different cell types to genotoxic agents;
- Fibres based on new polysaccharides with biological properties.

Below is an overview of the scientific and research focus of the departments and institutes of the faculty and their basic activities in 2021.

Department of Analytical Chemistry (KAlCh)

The scientific and research activities of the Department of Analytical Chemistry focus on both basic and applied research. The department focuses on analyses of organic and inorganic compounds using modern approaches. Special-purpose instrumentation allows the application of analytical procedures suitable for materials of different origin (biological and vegetable matrices, samples of food, water, soil air, etc.), not only in terms of the content of usual components but also in terms of trace analysis or toxicological analysis.

The Liquid Phase Separation Group focused on the development of methods for the determination of non-ionic surfactants based on oxyethylenated acylglycerols, separation of phenolic substances in vinegar food samples and metabolites of the second phase of biotransformation of selected drugs. In the field of two-dimensional liquid chromatography, work continued on evaluation of software with advanced procedures for background correction and compensation of gradient elution effects in both separation dimensions. In addition, focusing procedures for fraction transmission as part of 2D methods were developed and applied. In the development of electromigration methods, research focused on the possibility of using capillary electrophoresis for the determination of nanoparticles using a correlation of analyte-nanoparticle interactions including selected physical and chemical properties, such as dipole moment, octanol-water partition coefficient and acid-base properties.

As far as application outcomes are concerned, attention was on the optimization of HPLC/MS/MS conditions for the analysis of selected artificial sweeteners in food and beverages. A new stationary phase combining two separation mechanisms was tested for separation. Furthermore, phenylisothiocyanate derivatization for spectrophotometric detection of branched-chain amino acids in dietary supplements for athletes was optimized. The derivatives were separated by liquid chromatography in reverse-phase systems. In the field of applied research (qualified dye chemistry), cooperation continued with Synthesia, a.s. Focus was on the analysis of the content of target congeners of polychlorinated biphenyls in selected dyes and pigments. Their content in final products is one of the indicators of the quality of these dyes and pigments with a potential PCB content. The results will be used by Synthesia, a.s. to optimize the manufacture of these products in order to further improve their sales in the domestic as well as international markets.

The Mass Spectrometry Group continued the development of new methods for lipidomic analysis using UHPLC/MS, UHPSFC/MS and shotgun MS techniques. Key studies on the possibility of early detection of pancreatic cancer based on lipidomic analysis of blood were published in Nature Communications and other types of carcinoma (kidney, prostate and breast) in Scientific Reports. Another paper published in Nature Communications explained the importance of using reliable identification procedures in the reporting of detected lipids, which was the outcome of a joint effort of a wide team of authors from 24 departments including three co-authors from the Department of Analytical Chemistry. An article was published on the development of new software LipidQuant 1.0 for lipidomic quantification using chromatographic separation of lipid classes. The programme is freely available. Presently, a new version of the software is being developed, which will be compatible with different data formats and different analytical approaches. A detailed procedure for the structural identification of complex neutral glycosphingolipids using HILIC-UHPLC/MS in human plasma was described, followed by a study on the

significance of these lipid classes in the tissue and plasma of patients with pancreatic cancer in cooperation with the Swedish Institute of Biomedicine, University of Gothenburg. Cooperation continued on the technical implementation of two-dimensional online connection UHPSFCxUHPLC and subsequent application for the purposes of lipidomic analysis. The group also worked on the development of new methods for reliable identification of a large number of lipids and subsequent use of this method for a new quantitative procedure based on derivatization of polar classes of lipids, which resulted in a significant increase in sensitivity for some classes.

The Extraction Methods Group continued the research on the characterization of beer ingredients using HS-SPME in conjunction with GC-FID/MS, in a modification based on simultaneous application of vacuum and a combination of sorption temperatures. Attention was on volatile organic compounds in various types of malt (light, dark, caramel, etc.). The principle of repeated headspace extraction was tested for the determination of linalool in beers. The research also focused on the determination of selected pesticides in soil and water samples. A method for their determination using GC-MS in the Multiple Reaction Monitoring mode to achieve the highest possible determination sensitivity was developed. Research continued in the field of extraction of volatile substances from various types of plant matrices using traditional (distillation using water vapour, hydrodistillation) or modern extraction techniques (extraction using supercritical carbon dioxide, solid-phase microextraction) followed by GC-FID and GC-MS analysis. The effect of water pH in hydrodistillation on the yield and composition of essential oil was tested and the chemical transformation of volatile compounds in lavender oil hydrodistillation was monitored.

The Food Analysis Group, in cooperation with the University of Agriculture in Krakow, optimized the process of preparation of dried powder from aronia fruits using osmotic dehydration supported by ultrasound in order to maintain the highest possible content of antioxidants. Current experiments focused on modified starches in order to develop products with potential for further use in the food industry. Furthermore, the production of linden syrup was tested using traditionally dried and lyophilized plant material. The use of lyophilized linden flower resulted in a higher content of some phenolic substances. A new three-loop interface for two-dimensional liquid chromatography was tested. The system allows the inclusion of isoelectric focusing between separations in the first and second dimensions. The efficiency and function of this interface was compared with the commonly used interfaces for 2D-LC. A gas chromatography method with mass detection was developed for the determination of acrylamide in bakery products. The method is based on the derivatization of acrylamide using xanthydrol and subsequent liquid dispersion microextraction.

The Atomic Spectrometry Group in collaboration with the University of Parma continued to develop new analytical procedures for the authentication of selected types of food based on the determination of inorganic element profile by mass spectrometry with ionization in inductively coupled plasma and its evaluation by machine learning techniques, enabling sample classification with a high degree of sensitivity, specificity and accuracy. In cooperation with the University of Trnava, a study was performed on the distribution of risk elements in selected components of the ecosystem in and around the landfill of the former nickel works in Sered' in terms of both temporal and spatial dynamics. The determination of a multi-element profile in plant and soil samples was also used for laboratory experiments aimed at identifying the most suitable plant species with potential for subsequent effective use in phytoremediation.

The Electroanalytical Group tested the electrochemical properties of carbon paste electrodes depending on the type and viscosity of silicone oils used. For the characterization of reaction kinetics, iron and ruthenium ions and complexes were used (e.g. ferrocyanide, ferrocenmethanol and hexaminruthenium). Two electroanalytical methods were developed to control the quality of vegetable oils and monitor the selected sensory active substances in spices. Electrochemical characterization of carbon paste electrodes for non-aqueous environments and electrochemical deposition of amino-polymers for binding of artificial enzymes were performed. Work continued on the development and verification of a method for the simultaneous determination of Diklofenac and flufenamic acid on a carbon paste electrode modified in situ by surfactant.

The experimental conditions for simultaneous electrochemical detection of alpha-, beta- and delta-tocopherol were examined and optimized. Despite the partial overlap of analytical signals, the isomers

were eventually quantified. Together with the University of Defence and UJP Praha, a.s., the products of oxidative damage of the DNA of biological samples after exposure to ionizing radiation were electrochemically monitored. In cooperation with the Slovak University of Technology in Bratislava, boron-doped printed electrodes were tested for electrochemical detection of lipophilic vitamins in mixed aqueous-organic solutions.

In cooperation with the University of Lodz, a screening electrochemical method was developed for monitoring of fenhexamide pesticide residues on the surface of grapes in order to determine the optimum harvest time. Moreover, a flow injection analysis (FIA) method was proposed to determine the content of cocoa in chocolate to be used in quality control. As part of a GA CR project and in cooperation with Mendel University in Brno, cold catecholic activity of artificial enzymes against selected hypothalamus hormones was studied, where copper complexes served as a recognition biomimetic element suitable for FIA catecholamines.

In the area of isotachophoretic analysis, the group completed the research on different antidepressants and antiepileptics and verified the possibility of the determination of ethanol and denatonium benzoate. Together with the Department of Physical Chemistry, cooperation continued in the area of pharmacokinetic studies.

The Chemometric Group determined the thermodynamic dissociation constants of drugs by means of an analysis of spectrometric and potentiometric data.

Department of General and Inorganic Chemistry (KOAnCh)

The scientific and research activity of the department focuses on the chemistry of inorganic, organometallic and coordination compounds, catalyses, non-crystalline oxidic and chalcogenide glasses, thin layers and nanomaterials and thermoelectric materials.

The research in the fields of coordination and organometallic chemistry focused on the study of the structure, binding properties and applications of compounds as molecular precursors of new materials, catalysts and markers or therapeutic substances in medicine. Metal compounds of almost the entire periodic system containing predominantly chelating, voluminous or other modern ligands were studied. The department studied the reactivity of borane, thiaborane and carborane compounds with *N*-heterocyclic carbenes. In this class of compounds, a new reactivity in ten-vertex series of compounds was discovered. These compounds can be protonated to form the first cationic boranes and carboranes with unique properties suitable for material and biological applications. The 12-vertex carboranes were used to stabilize non-transition metal clusters. As part of the ongoing study of coordination compounds, the researchers synthesised compounds with bulky anilines and multidentate ligands – guanidinates. In the area of applied research, the department continued to study the preparation, properties and use of lactyl lactates as surfactants and cosmetic and disinfection ingredients, synthesis of polyglycerines or pigments for security printing.

Research also focused on the synthesis of new intramolecular coordinated N→GE germylenes, carbene or phosphine analogues. The department focused on the use of these compounds as two electron ligands for the synthesis of monomer complexes $(LGeCl)_2CuX$ (X = Cl, I, OAc, OTf, $acacF_3$) and monomer complexes $(LGeH)_2CuX$ (X = Cl, I, OTf, OAc, $acacF_3$) the structure of which included germylene LGeH. The compounds were tested for their catalytic activity in radical polymerizations of methacrylate on polymethacrylate. Research also focused on the synthesis and reactivity of neutral *N,N,O*-chelating ligands based on pyridine. Focus was on the examination of the autoionization reactions of $SnCl_2$, resulting in the synthesis of ionic compound $[LSnCl]^+[SnCl_3]^-$. These compounds were examined for their catalytic activity in polymerization reactions of L-Lactide for the preparation of linear polymers.

The department studied organometallic compounds of group 15, specifically the reactivity of unsymmetrical substituted compounds RR´MCL stabilized by N,C,N pincer ligands (R) against sterically demanding hydrides. The study confirmed considerable dependence on the used central atom M and pincer ligand; the process was accompanied by hydrometallation reactions and the formation of new heterocycles, element-element bonds (M-M) or stabilization of monomer hydrides with terminal M-H

bond. In addition, research on group 16 focused on the possibility of oxidation of organotellurium(II) cations to organotellurium(IV) analogues in order to increase their Lewis acidity and thus their reactivity with respect to the Si-H and B-H bonds.

In 2021, new derivatives of 1,2,3-diazapnictols condensed to carbon aromatic systems, i.e. heterocyclic analogues of pentalene and benzo[a]pentalene were prepared. Similar compounds with cyclopenta[a]pentalene and indene structures showed to be unstable and their synthesis was not successful. The prepared derivatives can easily be deprotonated to form intensely coloured polyaromatic anions, which were subsequently characterized by spectroscopic methods.

A multi-stage synthesis was performed to prepare a series of semi-sandwich complexes of tungsten with cyclopentadienyl ligand substituted by a side arm with a thioether functional group. Subsequently, their reactivity with N-donor ligands was studied. All of the isolated compounds were characterized using available analytical and spectroscopic methods.

As part of the ongoing cooperation with Výzkumný ústav organických syntéz, a.s. (Pardubice), quantum yields and the resulting colour of photoluminescent emissions of newly prepared organic and organometallic luminophores were measured and determined.

In the field of oxidic non-crystalline materials, research focused on phosphate lithium glass modified with molybdenum and tungsten oxide. Two selected types of glass of the mentioned ternary systems were further modified by adding titanium dioxide. The basic physical and chemical properties of the prepared glasses were determined and their structure was studied using Raman spectroscopy and ^{31}P MAS NMR. The study showed a different effect of adding WO_3 and MoO_3 in these glasses. An exceptionally positive effect on chemical resistance and increased temperature of glass transformation was observed especially in the case of WO_3 and TiO_2 additions. Cooperation with the Ruđer Bošković Institute in Zagreb continued on materials with ion-polaron conductivity. Sodium and lithium phosphate glasses were prepared for the study of electrical conductivity. In 2021, a monthly visit of two doctoral degree students from Croatia took place at the Department of General and Inorganic Chemistry. The result of the cooperation is a long-term joint publication activity.

The department continued a detailed study of the chemical composition and local structure of phosphate glasses with molybdenum. Glasses of three compositional series of the MoO_3-CaO-P_2O_5 system were synthesised. The work focused on obtaining the information concerning the local structure of the glass network by using ^{31}P MAS NMR, Raman scattering and electron spin resonance. Based on these results, chemical models describing these glasses were subsequently calculated. In addition, the thermomechanical properties of these glasses were studied and correlated with the chemical model. In cooperation with Alexander Dubček University in Trenčín, Slovakia and the Department of Glass and Ceramics, UCT Prague, the department continued thermodynamic modelling of the chemical composition of phosphate glasses with molybdenum. In cooperation with the Department of Physics of Pavol Jozef Šafárik University, Košice, Slovakia, the results of the study of the magnetic properties and dielectric spectroscopy of glass zinc-ferrous metaphosphate were published. A study of the glass structure of the NiO-ZnO-P_2O_5 system was initiated.

In cooperation with the Joint Laboratory of Solid State Chemistry, FChT, UPCE, a study in the area of oxide glasses with a high refractive index on the effect of Bi_2O_3 addition on the growth of micro-structures by direct laser writing into the PbO-Bi_2O_3-Ga_2O_3 system for the so-called metagallate structure 75PbO-25Ga_2O_3 was successfully completed. The resulting structures were dependent on laser intensity and exposure time; these conditions were decisive for the origination of microlenses, microcraters or planar optical waveguides. The study included the following parts: a) development of a thermal model of heat propagation in a material, where local heating to values close to the glass transformation temperature was confirmed; b) applicability of the created microlenses by means of imaging techniques.

In cooperation with CNRS-Université Bourgogne Franche-Comté in Dijon (France) and Charles University in Prague, a detailed study of thermal, structural and optical properties of BaO-ZnO-TEO_2 in the whole range of glass formation with a focus on refractive index correlation, chemical composition and glass structure was completed. Regarding their thermal and optical properties, the types of glass included in the study are perspective materials for fibre optics; therefore, selected types of glass were doped with

ER^{3+} ions. One of the current studies performed by the department focused on photoluminescent dynamics with regard to the chemical composition of the host matrix using stabilized, time- and frequency-differentiated photoluminescent spectrophotometry. As part of the study, La_2O_3-ZnO-TeO_2:Er^{3+} glasses were prepared. Currently, they are subject to characterization with an emphasis on their optical properties and achieving efficient upconversion photoluminescence in the visible spectrum.

In the area of chalcogenide glasses, a study was performed on the reaction in the region of double layers of steamed chalcogenides, where various techniques were used to confirm photo-induced reaction in the solid phase. The reaction range was controllable by time and wavelength and manifested by changes in the permeability of visible light. The study was performed in cooperation with the Joint Laboratory of Solid State Chemistry, the Institute of Applied Physics and Mathematics, FChT, UPCE and the Institute of Optical Materials and Technologies of Acad. Jordan Malinowski of the Bulgarian Academy of Sciences.

As part of international cooperation, other amorphous chalcogenides $(GeS_3)_{100-x}Ag_x$ (x = 0, 5, 10, 15, 20, 25) a $(GeS_2)_{100-x}Ag_x$ (x = 0, 5, 10, 15, 20) were prepared and studied. The microstructure of these volume glasses was analysed by means of scanning electron microscopy. It was observed that the glasses of both systems were phase separated already in the melt: $(GeS_3)_{100-x}Ag_x$ for $5 < x < 20$ at.% and $(GeS_2)_{100-x}Ag_x$ for $10 < x < 15$ at.%. The coexistence morphology of separated glass phases was dependent on glass composition. Phase separation was very distinctive $(GeS_3)_{100-x}Ag_x$ and was more suppressed in the $(GeS_2)_{100-x}Ag_x$ system.

In collaboration with Kumamoto University (Japan), a study was conducted on short and medium distance atomic arrangement in glasses with high optical permeability in the infrared region of the following structure: $(Ga_2Se_3)_{0,25}(GeSe_2)_{0,75}$ and $Ga_2Ge_3Se_9$. Their structure was examined using a combination of anomalous X-ray scattering (AXS), X-ray and neutron diffraction (XRD and ND) and reverse Monte Carlo (RMC) modelling. A combination of ND pair distribution function and the results of AXS and XRD resulted in partial structural factors and partial distribution functions of bonding pairs, even without the restriction on the shortest interatomic distances during RMC calculation. The total coordination numbers of Ga, Ge and Se atoms were 3.80; 4.68 and 2.25, which is contrary to 8-N rule. It was observed that the numbers of "incorrect" Ga-Ga, Ga-Ge, Ge-Ga and Ge-Ge bonds were in the same order 0.71; 1.32; 0.76 and 1.12. In the three-dimensional atomic configuration, the structure appeared to be inhomogeneous in terms of both density and concentration. Research in this area continues.

A study of thin layers of chalcogenide glasses prepared by the solution technique using the spin-coating deposition method focused on thin-layer deposition in ternary and quaternary composition systems by mixing the initial glass solutions. The study also focused on the possibilities of doping of thin layers by sterically stabilized gold nanoparticles. In addition to the spin-coating deposition method, focus was also on the dip-coating deposition method used for the application of thin layers by the solution technique. The prepared thin layers were structured by the hot-embossing method and the relationship between glass structure and the quality of the prepared structures was studied.

In the field of nano and polycrystalline materials, the department studied nanocrystalline cubic phases of $Yb_3Ga_5O_{12}$ doped with lanthanoids (Yb^{3+} and Er^{3+}). Photoluminescent spectroscopy was used to measure the Stokes emission (near the infrared region) and anti-Stokes emission/upconversion (in the visible region) using laser excitation at a wavelength of 977 nm. Life times and the effect of excitation radiation intensity for anti-Stokes emission were determined for both types of emissions. All of the doped nanoluminophores show red upconversion emission caused by a high content of Yb^{3+}.

The department also studied phase transformations from the amorphous phase to the crystalline phase in thin layers of $Ge_8Sb_{2-x}Bi_xTe_{11}$ (where x = 0; 1; 2) deposited by rapid thermal evaporation. Phase transformations were induced by ultra-fast femtosecond pulses (40 fs) resulting in changes in structure, optical properties and topography. The results showed that fs pulses could be used to achieve both crystallization and re-amorphization.

The combustion technique was used to prepare $Yb_3Ga_5O_{12}$: x Er^{3+} (x = 0,01–2 at.%), $Gd_3Ga_5O_{12}$: y Er^{3+} (y = 0,01–0,5 at.%) and $Gd_{2.9-z}Yb_zEr_{0.1}Ga_5O_{12}$ (z = 0; 1 or 2.9) nanocrystalline garnets, which were subsequently studied for their structure, chemical composition and optical properties in order to clarify upconversion photoluminescent dynamics after excitation by laser of a wavelength of ≈977 nm. The substitution of gadolinium with ytterbium in grenades $Gd_{2.9-z}Yb_zEr_{0.1}Ga_5O_{12}$ led to an increase in red Er^{3+}:$^4F_{9/2} \rightarrow {}^4I_{15/2}$ ($\lambda \approx$ 665 nm) upconversion emission intensity, while green Er^{3+}:$^4F_{7/2}/^2H_{11/2}/^4S_{3/2} \rightarrow {}^4I_{15/2}$ ($\lambda \approx$ 555 nm) upconversion emission in grenades $Yb_3Ga_5O_{12}$:Er^{3+} was almost suppressed. The measurement and analysis of data relating to stabilized and time-differentiated photoluminescent spectra revealed that the reason for the prevailing red upconversion emission in comparison with green upconversion was the presence of the reverse energy transfer processes of $Er^{3+} \rightarrow Yb^{3+}$ and cross relaxation of $Er^{3+} \leftrightarrow Er^{3+}$. These processes led to a faster and more efficient occupancy in level Er^{3+}: $^4I_{13/2}$ and at the same time to a vacancy in thermally coupled levels Er^{3+}:$^4F_{7/2}/^2H_{11/2}/^4S_{3/2}$. The subsequent energy transfer of $Yb^{3+} \rightarrow Er^{3+}$, i.e. Yb^{3+}:$^2F_{7/2}$ + Er^{3+}:$^4I_{13/2} \rightarrow$ Yb^{3+}:$^2F_{5/2}$ + Er^{3+}:$^4F_{9/2}$ led to an efficient occupancy in Er^{3+}:$^4F_{9/2}$, where relaxation to the base level Er^{3+}:$^4I_{15/2}$ caused red upconversion emission.

The optimization of the preparation of $BaCeO_3$ perovskites was commenced: x Er^{3+} (x = 0.02–2 at.%) by means of the combustion technique using citric acid. The objective was to prepare new effective luminophores and clarify the effect of the preparation conditions on chemical composition, structure and optical properties.

In the field of thermoelectric polycrystalline materials, research focused on the optimization of the thermoelectric properties of synthetic chalcopyrite $CuFeS_2$ as an affordable and non-toxic material. The other studied compound was $SnSe_2$, where the objective was to prepare layered composites with diselenides of transition metals, $MoSe_2$ or WSe_2. For this purpose, a series of nominal composition samples $(SnSe_2)_{1-x}(MoSe_2)_x$ a $(SnSe_2)_1$-x$(WSe_2)_x$ where x = 0 to 0.05 were prepared and characterized. Last but not least, the department prepared a series of polycrystalline samples of doped Bi_2O_2Se, where doping took place in the bismuth subgrid. Several series of samples of the following composition were prepared: ($Bi_{2-x}Tm_xO_2Se$), where Tm = V, Ni, Fe and Mn. The objective of the study was to find a suitable dopant in order to improve the thermoelectric properties of the initial matrix (Bi_2O_2Se).

Institute of Organic Chemistry and Technology (ÚOChT)

The research and development activities of the employees and students of the institute focused on the synthesis and characterization of new catalysts, biologically active compounds, compounds with defined electronic properties, study of organic reaction mechanisms as well as new technologies of organic intermediates and dyes.

In the research of the *Eschenmoser* reaction of substituted aliphatic and aromatic thioamides with 3-bromoxindoles, strong correlations between the structure, reaction environment and reactivity were identified. In addition, this reaction was studied with oxindole-3-yl-phosphate and triphtalate suggesting significant advantages of using triphtalate for the preparation of *N*-methylated analogues. The results were used in the development of an original synthesis strategy for two clinically used kinase inhibitors – Hesperadin and Nintedanib. A method was developed for the preparation of the diastereoisomers of selected 1-deoxysphingosine bases in the racemic form based on the application of the *Henry* reaction of relevant aldehydes with nitroethane and subsequent reduction of nitroaldol intermediates. The same strategy significantly improved the previously published synthesis of the antibacterial drug Linezolid and anticoagulant Rivaroxaban. A separate group of biologically active substances was represented by pseudopeptides derived from substituted salicylic acid. Their original synthesis was conducted by gradual development of the peptidic chain and subsequent functionalization of the prepared skeleton. Within the long-term study of palladium-catalysed reactions on substrates containing two variously basic conjugated or isolated control groups, a method was developed for easy control (switching) of the regioselectivity of palladium catalysed C-H activation reactions using additional acids. In addition, the original palladium catalysed *Michael* asymmetric enantioselective additions of arylboronic acids to

various types of acceptors (conjugated cyclic enones and β-nitrostyrenes) were performed using a recyclable catalyst applicable in a flow reactor.

The basic material research focused on functionalized organic compounds with significant photophysical and photocatalytic properties and properties enabling applications in the field of electrical energy storage. Attention was on conjugated π-systems and on examining their (non)linear optical properties. As part of this research, a series of tripodial push-pull fluorophores based on triphenylamine carrying peripheral diazine units (pyridazine regioisomers, pyrimidine and pyrazine) were prepared. These fluorophores were examined for their basic thermal, electrochemical and optical properties. In addition, a study of two-photon absorption was performed. As part of a synthesis of new organic electrolytes for aqueous flow-through batteries, new derivatives of the viologen were prepared with systematically changed π-system of naphtyridine. Modifications of the π-system allowed tuning of the course and stability of electrochemical redox reactions, while the type of quarternization of these azines allowed the search for a compromise between the solubility of the oxidized and reduced form in water. Another area of interest was the synthesis of a comprehensive range of dibutylthiobarbituric acid derivatives with substitution by the basic types of five-membered heterocycles. These systems were studied and analysed for the effect of the bonded type of heterocycle on their physical and chemical properties. In the second case, the analysis focused on two series of derivatives of ferrocene with pyridine and quaternized pyridine nucleus with an emphasis on electrochemical properties. Moreover, new emissive chromophores and co-monomers were synthesized and used for the preparation of emissive polymeric materials with scintillation properties. Another area of interest related to the issue of covalent organic frameworks (COF). This activity was based on a previous research study during which the first covalent sp^2-C frameworks were synthesised based on *s*-triazine and benzene-1,3,5-triacetonitrile. At the same time, a series of low molecular structural analogues of COF molecules were prepared. Last but not least, attention was on volatile organic compounds of selenium and also tellurium as precursors for atomic layer deposition (ALD). The portfolio of volatile organic compounds of selenium was expanded by including a full range of four-, five- and six-component cyclic silylselenides. A new preparative method based on the direct and easy reaction of elemental selenium with chlorosilanes was developed. The newly prepared 2,2,4,4-tetraisopropyl-1,3,2,4-diselenadisilethan featured both chemical and thermal stability and reactivity and successfully reacted with molybdenum(V) chloride to form molybdenum(IV) selenide. A detailed characterization of the applied high-purity 2D sheets of molybdenum(IV) selenide revealed their orientation outside the matrix plane. For the first time, the synthesis of molybdenum(IV) telluride nanolayer using ALD was demonstrated. The last area of interest was the development and verification of a methodology for the preparation and characterization of polymers with imprinted pesticide molecules. The prepared molecular imprinted polymers will subsequently serve as their highly selective sorbents for the electroanalytical determination of these xenobiotics from environmental components.

Department of Physical Chemistry (KFCh)

The scientific and research activities at the Department of Physical Chemistry are conducted in the following four areas: (a) Surface chemistry and catalysis; (b) Kinetic phenomena in glass forming systems; (c) Conversion of oils into valuable products; and (d) Applied chemical kinetics and pharmacokinetics.

In 2021, research on advanced porous materials and fundamental adsorption studies focused on the localization and strength of acid centres in the zeolite MOR matrix as well as their interaction with carbon monoxide as the test molecule. It was confirmed that the distribution of aluminium in the grid was highly non-statistical, while the preferred crystallographic positions were T3 and T4. Based on a detailed analysis of the IR spectra of adsorbed CO, two C-O vibration spectral lines were distinguished and clearly matched with the adsorption complexes in the main channel and the side pocket. This conclusion

appeared to be independent of the Si/Al ratio and was further supported by a solid agreement between the calculated adsorption enthalpies and calorimetric measurements. Exceptionally large dispersion stabilization was observed in adsorption complexes in the side pocket thanks to the specific topology of the MOR side pocket. The results of this in-depth study published in Microporous Mesoporous Materials corrected the frequently misinterpreted IR spectra.

In cooperation with CEMNAT, a method was developed for the preparation of WO_3 microfibres using centrifugal spinning. The structural characteristics and photocatalytic properties of WO_2 fibres were published in Ceramics International and the method for the preparation of these fibres is part of a granted patent.

In the area of heterogeneous catalysed reactions, attention was on the stability and catalytic activity of the palladium and platinum nanoparticles encapsulated in MFI zeolite in various hydrogenation reactions. In cooperation with the team led by Prof. Čejka from Charles University, a new synthetic strategy was developed for the stabilization of metal nanoparticles in MFI zeolite. For the first time, imidazolium-type ion fluids with functional alkoxysilanes (ImILs) were used as auxiliaries to protect metallic precursors (Pt and Pd) during the thermal synthesis of MFI zeolite. Positively charged imidazolium groups in ImILs interacted with negatively charged metal precursors ($PtCl_4^{2-}$, $PdCl_4^{2-}$, etc.), while alkoxysilane groups participated in zeolite crystallization. Scanning transmission electron microscopy showed that most Pt and Pd nanoparticles (size of approximately 1.0 nm and 1.7 nm) were closed in channels or channel intersections of MFI zeolite. The characterization of the catalysts confirmed a significantly higher stability of nanoparticles encapsulated in the zeolite structure, even after treatment in high temperatures (above 550 °C in an oxidation environment). The results of the study were published in the prestigious Chemical Engineering Journal.

The oxidative dehydrogenation of ethane was studied on a binary eutectic mixture of KCl and $MgCl_2$ applied to La-FAU zeolite. The catalyst was prepared by heat treatment of La-FAU by a mechanical mixture of alkaline chlorides under helium flow at 500 °C. The synthesized fresh as well as used catalysts were characterized in order to obtain information on the changes in crystallization, textural properties, crystalline phase content, chemical composition and morphology of the catalyst depending on the time of reaction. The initial ethane conversion reached up to 80 % with ethene as the main product (up to 65 % yield). Unfortunately, however, very significant catalyst deactivation was observed. The characterization methods confirmed that the reason for catalyst deactivation was the gradual removal of chlorine from the catalyst. The mass spectroscopy of the gaseous reaction products demonstrated the presence of chlorinated hydrocarbons. The exchange of chlorine to oxygen in the catalyst led to a significant decrease in the activity and production of higher hydrocarbons and their oxygenates as by-products of the ODH reaction. The results were published in Catalysts.

In the area of photocatalysis, focus was on hydrogen generation as part of photocatalytic degradation of methanol-water solution.

Research in the area of basic heterogeneous catalysis focused on layered double hydroxides (LDH) of different compositions (Ca^{2+}, Mg^{2+}, Zn^{2+} and Al^{3+}, Fe^{3+}), mixed oxides formed by LDH heat treatment and the so-called "reconstructed" LDH and their use in aldol condensation of furfural, Guerbet reaction (conversion of ethanol to butanol) and transesterification of vegetable oil. Attention was on (a) acid-base properties of the materials studied, and (b) analysis of the relationship between their structure/composition/basicity and activity/selectivity of the reactions. The research was conducted in cooperation with ORLEN UniCRE (transesterification of vegetable oil and Guerbet reaction) and Technopark in Kraupy of the University of Chemical Technology (aldol condensation of furfural).

In the field of oil chemistry, focus was on the epoxidation of vegetable oils and products from these oils (esters, fatty acids and their mixtures). In particular, the research focused on (i) the conditions of epoxidation under which the epoxy achieved the required properties and (ii) the analytical methods for the determination of the quality and quantity of the final epoxy product and reaction monitoring, especially by means of HPLC and GC-MS. The process of epoxidation produced substances with higher oxidation stability usable as a replacement for petroleum-based lubricants or as plasticizers. The department focused on the use of epoxy for polymer chemistry (monomers for polymerization) and

carbonates (reaction with CO_2). The research was carried out in cooperation with ORLEN UniCRE, a.s. and Paramo, a.s.

In the field of non-crystalline materials, study continued on the physical properties (viscosity, surface diffusion, thermal capacity, surface tension, etc.) and kinetic processes (crystallization, structural relaxation) that take place not only in chalcogenide glass forming materials. In 2021, research focused on the study of the physical properties (viscosity, self-diffusion, surface tension, thermal properties) in bulk samples and thin layers of amorphous chalcogenide materials using a wide range of experimental techniques (microscopy, AFM, DSC, TMA, nanoindentation). In cooperation with Leibniz Institute for Photonic Technology (IPHT, Jena, Germany), viscosity was studied in the melts of the prepared chalcogenide materials. Attention was also on the study of the kinetics of the processes that take place in these materials (structural relaxation, crystallization) using direct (microscopic) as well as indirect (DSC, TMA) methods. The combination of direct and indirect methods based on the knowledge of temperature dependence of physical properties led to a better understanding and prediction of these processes in glass-making, not only chalcogenide systems. In cooperation with CEMNAT, a method was developed for measuring crystal growth in thin layers of chalcogenide glasses paired with calorimetric measurements of the native form of these layers. This study also included the effect of the substrate on crystal growth in the prepared thin layers. In cooperation with Alexander Dubček University in Trenčín, the thermokinetic properties of phosphate-based oxidic glasses were studied. As part of theoretical research on the kinetics of solid phase processes, the study focused on the applicability of the nuclear growth model and on the use of neural networks in the kinetic analysis of thermoanalytical data.

In 2021, research on solid pharmaceuticals focused on the preparation and development of mixed fibres for 3D printing of matrix tablets, optimization of the process matrix tablet coating using 3D print and the development of a method for 3D printing of capsules. In the context of fibre development, attention was particularly on the possibility of using the mixtures of synthetic (Kollidon, PVA, hypromellose) and natural (chitosan, alginate, pectin) polymer in order to achieve the highest possible proportion of natural polymer while maintaining the desired fibre properties. The new fibres were characterized by EDX, SEM and FTIR. Fibre disintegration was studied in various media that simulate the GIT environment. On the basis of these results, a 3D printing method for matrix tablet coating was developed and optimized to minimize the risk of 'alcohol-induced dose dumping' effect in tablets with a prolonged release of the active substance.

One of the parts of the research focused on the development of the model and 3D printing of capsules. Several types of capsules were developed from various polymer materials differing in the type of closure, shape and size. The capsules were tested according to the requirements of the Czech Pharmacopoeia. The study was performed in cooperation with the Faculty of Pharmacy of Masaryk University in Brno.

Institute of Environmental and Chemical Engineering (ÚEnviChI)

The scientific and research activities are conducted in the area of basic and applied research by means of contract research, additional activity as well as consultation and counselling services in line with the long-term focus of the scientific teams of the institute.

In the area of membrane processes, the activity of the institute focused on acquiring further experimental and theoretical knowledge in order to extend their application potential. In this context, the use of pressure membrane processes focused on the disposal of contaminated waste water and treatment of technological water including drinking water. The main activity in the area of nanofiltration was the study of the effect of significant parameters on the separation of heavy metals, such as the concentration of a heavy metal in a solution, pressure difference above and below the membrane, membrane type, etc. on the selected characteristics of this pressure membrane process (intensity of permeate flow and system component rejection). The method of separation of selected drug residues from water-based solutions using nanofiltration was tested. The procedure used similar parameters as in the testing of heavy metal separation.

The Diffusion Dialysis Group was involved in experimental research of continuous diffusion dialysis of mixtures of sulphuric acid and sodium sulphate using the ion-exchange membrane Neosepta-AFN. The research was carried out for ORLEN UniCRE, a.s., specifically for a project focused on the regeneration of sulphuric acid from automotive batteries.

In cooperation with MEGA, a.s. and Membrain, s.r.o., the following project funded by the Ministry of Trade continued: FV 40062 *Zero liquid discharge of industrial waste water using electrodialysis*. The results of the research were presented at the MEMPUR 2021 conference. A master's theses was completed on the study of the selectivity of salt transport during the electrodialysis of salt mixtures with a common anion.

In collaboration with VÚOS, a.s., the study of *in vitro* testing of skin penetration of chemicals on porcine skin and artificial Strat-M membrane continued. This was an alternative dermal toxicity test. The method is based on OECD methodology No. 428 and uses a vertical static diffusion chamber according to Franz.

The activities of the chemical technology group of ÚEnviChI (excellent applied research – project VA390013) focused on the ecological aspects of chemical processes. The group focused on the removal of industrially significant chlorinated and fluorinated aromatic compounds (Diclofenac, flufenamic acid, azo dyes and their by-products) from real technological and wastewater using the best available techniques such as sorption, ion exchange, coagulation and flocculation. In cooperation with VÚOS, a.s. and Synthesia, a.s., the group performed applied research and experimental development funded by TA CR under the project GAMA 2-01/005: *Removal of dangerous compounds from contaminated waste applicable for recycling according to the circular economy*. The procedure allowed the concentration of halogenated organic acids and regeneration of the sorption charge using suitable surfactants. To address the issue of the treatment of the concentrates of separated contaminants, the process of degradation of halogenated derivatives in wastewater using chemical reduction (hydrodehalogenation) was analysed.

In addition to the activities described above, the group initiated the project TA CR GAMA 2-03/009 *Increasing the resistance of textile personal respiratory protection by viricidal impregnation, Part II* aimed at the preparation and testing of the biocidal efficacy of new formulations as well as the existing functional sample of biocidal formulation and at testing of their harmlessness for the purposes of individual applications in order to increase the resistance of textile respiratory protection (masks).

Under the Epsilon scheme of the Technology Agency of the Czech Republic the group cooperated with TERAMED, s.r.o. and the Potato Research Institute Havlíčkův Brod on the following project: *Biocomposite component for slow release of active minerals in soil for plant nutrition* aimed at semi-operational monitoring of phosphorus and nitrogen activity in soil under the presence of biologically treated zeolites. The application outcome of the project is a functional sample of newly designed fertilizer preparation which makes phosphorus available from soil unavailable to plants consisting of nature-friendly materials both in terms of mineral and biological composition (all of the microorganisms used are normally present in nature and these taxa are not pathogenic) as well as lightens heavy soil in the root system area and becomes an integral part of the soil environment.

By means of contract research, a project was carried out for Ecocoal, s.r.o., Ostrava concerning the processing of dust leaches from metallurgical production and the development of a rubidium yielding technology. The outcome of the project is utility model No. 35730 *Production line for yielding selected metal compounds from the product of off-gas purification*, describing a set of 28 technological apparatuses enabling the introduction of rubidium production in the Czech Republic.

By means of contract research, a project was commenced for Ecocoal, s.r.o., Ostrava and Feromagnet, s.r.o., Světlá Hora entitled *Exploration of the processing of tungsten roasted product to form ammonium paratungstate and cobalt(II) sulphate* which is intended for the introduction of industrial production of tungsten and cobalt compounds in the Czech Republic, specifically from waste materials, and thus achieving independence on the world's largest supplier.

Together with EPS Biotechnology, s.r.o., and Tomas Bata University in Zlín, a project was continued under the 4th TA CR Zeta applied research public competition. The project dealt with the removal of chloroacetanilide pesticides from contaminated water and soil.

The project TA CR GAMA 2-03/006 *Equipment for capturing metal ions from polluted waters by biological immobilization and possibilities for commercialization* was initiated. The aim of the project was to verify the application potential and commercialization of the equipment for capturing metal ions from polluted waters by biological immobilization.

In the context of monitoring of the effect of products and technologies on the environment, a study was initiated on waste textile treatment, collection and further processing. Data was collected for the assessment of the effect of selected technologies for secondary processing technologies for textile waste on the environment.

A study was conducted to monitor the content of elements in crops intended for the food industry. A positive gadolinium anomaly was observed in a sample of dried mushrooms, which was assessed with respect to the origin of the sample. Due to the increasing use of gadolinium-based contrast agents, their spread in the aquatic environment and the potential for contamination of food chains, the group assessed other plant monitors and basic agricultural products in which gadolinium of anthropogenic origin is monitored. At the same time, the specific chemical forms of gadolinium and their bioaccumulation as well as individual effects on gadolinium anomaly in the tested organisms were assessed under laboratory conditions.

The ecotoxicology group performed a TA CR project *Combined procedure of elimination of chloroacetanilide pesticides from contaminated water and soil*, focusing on the study of the toxicity of chlorinated pesticides before and after their elimination from freshwater and soil organisms using modified or newly introduced miniaturized test forms. The group also focused on the optimization of immunochemical biomarkers of toxicity in annelids in cooperation with the Department of Biological and Biochemical Sciences of FChT.

In cooperation with CEMNAT, a large set of samples of particles of various properties (granulometry, morphology) was prepared using the technique of cryogenic grinding from polyacrylonitrile nanofibres. These samples were intended for subsequent study of the key parameters that affect particulate toxicity. In collaboration with the Institute of Hydrobiology of the Czech Academy of Sciences, the group implemented a project addressing the effect of periphyton on the movement of phosphorus in oligotrophic lakes of reclaimed mines. In cooperation with the Ministry of the Environment, a study was conducted on the possibility of reporting of per- and polyfluorinated substances (PFAS) to the Integrated Pollution Register (IRZ).

Research also focused on the development of new voltammetric methods for the determination of selected bioactive substances important to human health and the environment by using prospective electrode materials. The group completed and assessed studies on voltammetric behaviour and the determination of azole fungicides of difenoconazole, tebuconazole and triticonazole using the Boron Doped Diamond Electrode (BDDE) and proposed a mechanism for their oxidation. Other substances involved in the study were the drug mephenoxalone and the vitamin hydroxocobalamin. Attention will be on the development and testing of printed sensors with chemically deposited BDDE. These sensors showed to have very good electrochemical properties, especially sensitivity, repeatability and reproducibility. Their applicability was verified in an analysis of practical samples of pharmaceuticals and pesticide preparations.

In the area of development of voltammetric methods for the determination of preparations for plant protection, a sensitive method for the determination of mephentrifluconazole was developed. This is an innovative fungicidal substance effective against a wide range of diseases. A frequent accompanying agent in application preparations is fluxapyroxad fungicide. Therefore, attention was also on this substance. The newly developed method allows the determination of both fungicides.

The study of energy consumption E [kWh·m^{-3}] during DC-galvanostatic elimination of Zn from selected model as well as industrial waters on the Cu-electrode, taking into account the mechanisms of transport of the charge and polarization resistance, provided 3D diagrams of the measured values of E vs. current density i [mA·cm^{-2}] and specific conductivity κ [mS·m^{-1}] after 2 and 5 hours of electrolysis. The results became reference values for further research (electrode materials, working modes, etc.) necessary to reduce the energy requirements of these processes.

The research on the indication of the process of cleaning selected power plant/heating plant waters based on the changes in the potential of the AgAE silver amalgam electrode in the presence of Ag^+ identified the conditions in which the standard deviation (repeatability) during the measurements in the technical mode decreased to about ±2-3 mV. The time stability of mixed potentials E_s AgAE (depending on sample type, electrode history, etc.) was in the range of ±5-10 mV (generally acceptable value). This area will be subject to further research.

Cooperation continued with the Institute of Electronics and Photonics FEI STU Bratislava in order to test and use new electrode materials, especially BDD electrodes. In this context, a higher-life BDD flow cell is being developed and will be tested on model and real wastewater. Cooperation continued by means of contract research with Glanzstoff Bohemia, s.r.o. in the area of zinc separation and regeneration in waste and industrial waters by optimizing Katex filters and their regeneration. The cooperation also included the use of AOP processes in the oxidation of organic pollution in wastewater. Emphasis was on increasing the effectiveness using new cathode materials based on Pt, Au or Pd plated titanium. Focus was also on the application of these electrodes in suppressing AOX produced during electro-oxidation of organic compounds in the chloride ion environment in comparison with BDD electrodes.

In the area of remote sensing and monitoring of surface water, further samples were taken (using the developed floating sampling device) to expand the data base of water quality parameter models based on the remote monitoring approach. Focus was also on continued development of models and optimization of satellite data processing.

In the area of rheology, the group focused on the identification of rheological properties of samples of polyurethane adhesives and their components using the so-called serrated geometries and also on the identification of rheological properties of gels used in pharmacy. In addition, experiments were carried out as part of a master's thesis on the fall of non-spherical particles (ellipsoids) in Newtonian fluids in the field of the flat flow. The results were subsequently compared with theoretical solutions.

Institute of Chemistry and Technology of Macromolecular Materials (ÚChTML)

The Institute of Chemistry and Technology of Macromolecular Materials performed research in areas that are unique in the Czech Republic. The Institute has three departments with long-term scientific-research focus: Department of Paints and Organic Coatings, Department of Synthetic Polymers, Fibres and Textile Chemistry, and Department of Wood, Pulp and Paper.

Scientific activity in the area of organic coatings and paints includes comprehensive research of these materials with an emphasis on the binder as well as chemically or physically active coating components, i.e. pigments, fillers and numerous functional additives. Research focused on the development of polymeric and composite coatings, nanomaterials and special polymers. Attention was on cross-linking reactions on polycondensation and polyaddition resins, binders made of renewable sources and environmentally friendly materials. At present, strict focus is on ecological and toxicological safety of paint and organic surface components. Therefore, attention was on organometals potentially applicable in the area of paints. Detailed focus was on organometallic derivatives for oxopolymerization drying of alkyd paints whose Cp ligand carries electron acceptor substituents. The mechanism of their effect in autooxidation reactions was studied by means of spectroscopic methods. Focus was on searching and studying new antioxidants for paints and optimization of their application. Another research area was the synthesis of ecological and highly efficient anti-corrosion pigments and corrosion inhibitors and the study of the mechanisms of their effect in the protection of metal materials. A promising solution seemed to be the use of the synergic effect of compounds that limited the speed of corrosion reactions –

corrosion inhibitors with other components of protective organic or inorganic coatings. The institute focused on synthesising oxide nanoparticles and morphologically interesting pigment particles intended for efficient interconnection of the polymer network of the protective film. Core-shell particles with an active nanolayer inhibiting the course of a certain corrosion reaction were developed. Conductive polymers and carbon nanomaterials as active inhibitors of corrosion reactions were studied. Focus was also on the formulation of organic coatings containing conductive polymers, where a very promising alternative seemed to be composite particles of conductive polymers and their suitable carriers. For the preparation of nanodispersions with zinc oxide in organic solvents, dispersion techniques including appropriate conditions and additives that facilitate these technologies were developed. The prepared nanosuspensions are used as anti-corrosive and anti-microbial agents in paints.

In the area of anti-corrosion coatings for heavy corrosion protection, focus was on investigating the properties of paints with a high content of zinc and the aim was to decrease the content of this metal using other electrically and electrochemically conductive materials. Research was carried out in the area of syntheses and application of anti-corrosion pigments with various chemical structures and particle morphologies. Pigment modification by conductive polymers was performed to increase the anti-corrosion efficiency of anti-corrosion pigments or corrosion inhibitors, reduce the amount in paints and improve the mechanical properties of binders. Focus was also on the formulation of thermally and chemically stable coatings and layers containing metal particles or nanoparticles of ferritic pigments.

Focus was also in the synthesis of new metallic complexes and organometallic compounds, which were subsequently tested as catalysts in ring-opening polymerization of cyclic esters. Attention was not only on the preparation of linear aliphatic polyesters but also on the synthesis of polymers with a star-shaped structure. Research also focused on new polymer compounds used for surface treatment of various materials in order to increase their hydrophobic properties, sliding properties, resistance to dirt, etc.

In the area of polymeric and textile chemistry, research focused on chemical technology, automotive industry, textile chemistry, design and composite materials, processing industry, medicinal materials, energy materials, etc. Scientific activity included the study of polymerization and polycondensation reactions. Material research was performed in the area of composite materials and construction adhesives for the automotive industry. Attention was on composite materials of different matrix composition and reinforcement by means of manual deposition technology and vacuum infusion from materials used in the aerospace or shipping industry. The effect of the composition of composite materials on their physical and mechanical properties and their moisture susceptibility in an aqueous environment was also studied.

Focus was also on the study of biodegradable polymers on the basis of polymerable sugars and biodegradable auxiliaries in textile chemistry. In the area of reactoplastic materials, research focused on the modification of epoxy resins, adhesives and sealants. Important thermoplastic polymers include polyethylene and resilient polystyrene, whose macromolecules contain polymeric-bound light stabilisers and antioxidants. The purpose of these polymeric carriers is to improve UV stabilisation and decrease oxidative degradation of, for example, polyurethanes and other polymers. Research also focused on other additives (antistatics, flame retardants and fluorescent markers) covalent-bound to plasma-treated polymer carriers. Emphasis was on the development of environmentally acceptable flame retardants based on lignin nanoparticles. Research also focused on the synthesis of reactive structured polymer parts using the technique of emulsion polymerization, their properties and applications, particularly in the area of surface treatment. The purpose of these research activities was to develop antimicrobial protective polymer coatings based on hybrid polymer dispersions which contained inorganic nanoparticles of metal oxides. Focus was also on the study of increasing water resistance of latex films. The subject of research in the field of emulsion polymerization was the development and evaluation of innovative acrylic polymer dispersions which were designed as modifying additives for cement composites intended for construction. New formulations of polymer dispersions were developed on the basis of standard as well as renewable materials. These dispersions decrease the formation of air bubbles in Portland cement mortar, thus eliminating the need for additional anti-foaming agents and giving the building materials better mechanical properties and water tightness. Another area of research was the development of synthetic latex used as an effective ecological adhesive in Fused Filament Fabrication (FFF) for 3D printing of polymer materials (polypropylene, polyethylene and polyamide) that

showed insufficient adhesion to the printing pad. Research also focused on the development of latex binders for varnishing applications that require increased fire protection. For this purpose, acrylic latexes with structured particles containing hexaamino-cyclo-triphosphate units and 2,2,2-trifluoroethylmethacrylate were synthesized.

Another area of study included heterogeneous ion-exchange membranes on the basis of emulsion polyelectrolytes as polymer carriers and functionalized styrene-divinylbenzene resin. Focus was also on the synthesis and study of hyper-branched polymers as precursors of organic coatings.

As part of the research of medical materials, staple fibres from the hyaluronic acid were developed not only for use in wound dressing but also in other areas of medicine. Focus was also on the study and subsequent application of the antimicrobial properties of various organic compounds, such as the aspartic acid or compounds containing copper or zinc in their molecule. In the field of final adjustments, research focused on anti-shrinking modifications as well as the study and subsequent optimization of the cationization of cotton materials. Research also focused on the study and use of surfactants, not only in pre-treatment but also in the process of dyeing and other final adjustments of textile materials.

Scientific and research activity in the field of wood, pulp and paper focused on biomaterials, both on the theoretical and practical level. Attention was on environmental issues related to the production and use of these materials, including combinations of paper and paper materials with other biomaterials and synthetic polymers. Special attention was on technological water and wastewater and their recirculation. Traditional focus was on the study of the principles of paper processing technology and the properties and behaviour of paper-based materials. Research focused on the development of pulp production, especially from annual plants and biowaste. Another important programme in the upcoming period is research on the properties of pulp-based fibres in the process of their ageing with respect to their life, recycling and protection of written heritage. Research also focused on surface treatment in paper refining and use of paper as a bioremediation and bioactive foil for the purposes of intensification of plant activity in agriculture. Explorational activity focused especially on better characterization of the epimolecular structure of lignocellulosic mass and other materials, particularly on the hypermolecular level, which is the key aspect in all molecular-surface, chemical and biochemical processes, as it is the first when molecules from the surrounding environment enter its core. The area of separation of wood, pulp and paper focused on circular economy based on renewable sources with a closed product lifecycle and on the reduction of non-renewable materials in fast-moving packaging materials.

Institute of Energetic Materials (ÚEnM)

The scientific and research activity of the Institute of Energetic Materials focused on several traditional areas:

The institute focused on the research and development of energy compositions based on co-crystals of attractive nitramines and other energy materials with high nitrogen content. The density of the prepared co-crystals exceeded 99 % of the theoretical maximum density of the initial nitramines. At the same time, new findings were obtained concerning the behaviour of energy nitrocompounds, chemical and biochemical syntheses and the detection of energy materials.

In the field of pyrotechnic mixtures, emphasis was on the testing of smoke mixtures for the production of red smoke as well as on the possibility of influencing the ballistic parameters of pyrotechnic mixtures by using zirconium salts as the main fuel component and various additives in the conditions of electric initiation.

In the field of solid fuels, the institute focused on the preparation of heterogeneous solid fuels based on ammonium perchlorate and hydroxyl-terminated rubber. The effects of various burning modifiers and other energy materials were examined.

Another joint project funded by TA CR continued with Explosia, a.s. focusing on the development and characterization of heterogeneous rocket fuels and an analysis of production waste acids.

Attention was on the research of the structure and properties of tetrazene, an explosive used in initiators. New interesting facts were revealed and published concerning the chemical structure and sensitivity of this explosive which had been used over a hundred years. Shock sensitivity and friction for tetrazene and its salts were determined. The reaction conditions responsible for the formation of two different crystalline modifications were examined, including a comparison of the differences in sensitivity to mechanical stimuli. The material characteristics and sensitivity to external stimuli were determined for tetrazene with various additional and stabilizing agents.

In the area of explosion physics, direct and indirect measurement was performed to monitor detonation and its effects on the near environment using both traditional pressure sensors and prospective optical methods. Part of the experiments was numerically simulated using the LS-DYNA software. A new methodology for the measurement of fast flying objects was developed using a series of simple optical sensors located along the expected flight path. The speed was calculated from the time of the arrival of the optical signal from the positions of the sensors.

In the field of safety engineering and risk analysis, a procedure was completed and published allowing the involvement of risk sources associated with exothermic reactions in risk assessment.

Department of Inorganic Technology (KAnT)

Scientific and research activity of the Department of Inorganic Technology focused on the following three principle areas: inorganic pigments, industrial fertilizers and soil improvers (special agrochemicals) and the study of the thermophysical properties and phase changes of inorganic substances by calorimetric and thermoanalytical methods.

In the area of inorganic pigments, attention was on the synthesis of new oxide materials, including their high thermal stability and appropriate optical properties, to be used as inorganic pigments and in commercial ceramic glazes and organic binders. Research focused on compounds, especially those of a pyrochlore, perovskite and spinel structure as well as phosphates. The composition of these oxide materials is affected by rare earth elements and transitional elements, which can have a positive effect especially on the optical properties of the synthesised compounds. The prepared substances were characterized in terms of their phase composition, optical and physical-chemical properties, thermal and chemical resistance, light stability and applicability in various binders. In the case of perovskite compounds, focus was also on their capability of reflection in the near-infrared region, which depended on the composition and type of perovskite structure. Specifically, the compounds included $SrSnO_3$ and $SrTiO_3$. In the case of phosphates, attention was on the preparation of compounds $Ni_3(PO_4)_2$ and the verification of the effect of the method of synthesis on the colouring, phase composition and structure as well as thermal stability. In cooperation with a foreign partner, a test was carried out of $Co_5Cr_2(P_2O_7)_4$, which is a new type of pyrophosphate that provides a varied colour scale and at the same time is thermally stable. Research also focused on the testing of various conditions of hydroxyapatite precipitation in terms of its corrosive-inhibitory effects with applications in various binders and subsequent evaluation of corrosion tests. The synthesis of new oxide materials was based on solid phase reactions, precipitation, sol-gel method, suspension mixing of raw materials and also mechanoactivation. Focus was also on the testing of various input materials in order to achieve a positive effect on reactivity. In the process of synthesis, focus was on the application of various types of mineralizers and defined atmospheres in order to achieve a positive effect on the course of the synthesis.

The research on special agrochemicals focused on the synthesis of hydrogel, one of the components of which was starch obtained from the fruit of the horse chestnut (*Aesculus hippocastanum)* and red oak *(Quercus rubra)*. The conditions of isolation and purification of these starches were optimized and insulation yield was identified. Isolated starches were characterized by a thermogravimetric analysis and the content of amylose and amylopectin in starch was identified by a calibration series. As a result, all of the prepared hydrogels may be a suitable ecological alternative to commercial fully synthetic polyacrylamide products. Procedures for the determination of selected components of commercial

biocidal products were developed and verified in the analytical laboratory. A completely unique method was developed for the determination of glyoxal using HPLC with a refractometric detection on the Hi-Plex Ca column. In the context of the research, long-term tests of active component stability in biocidal preparations were performed in order to comply with the requirements for the registration of these preparations according to EU regulations. The research was carried out in cooperation with an industrial partner.

The study of thermophysical properties and phase changes focused primarily on two groups of materials – chalcogenide glasses and inorganic salt hydrates. Research on chalcogenide materials focused on the study of the thermal capacity of these materials. In this area, a methodology was developed for experiments performed in an inert atmosphere applied to specific basic chalcogenide materials, both in the glass and crystalline form. Focus was also on the viscosity behaviour of chalcogenides. In addition to acquiring further experimental data, the research also focused on the possibilities of combining experimental data with suitable theoretical models and on the possibility of estimating the viscosity behaviour in supercooled melt where direct detection of experimental data is compromised by the process of cold crystallization of the supercooled melt. The kinetics of structural relaxation was studied for pseudobinary silver-doped GeS_2-Sb_2S_3 glass and the determined kinetic parameters were compared with the viscosity behaviour of the material. In the area of substances suitable for heat accumulation, research continued on the effect of doping of inorganic substances on the suppression of supercooling in nitrate hydrates and sulphate hydrates. Moreover, the tests focused on the effect of the addition of inorganic fibres to these salts to suppress phase separation. The prepared mixtures were characterized by TG/DSC or just DSC. At the same time, the values of thermal capacity, density and thermal conductivity at room temperature were determined.

Department of Graphic Arts and Photophysics (KPF)

The scientific and research activity of the Department of Graphic Arts and Photophysics focused on several different areas.

The first area of research focused on chalcogenide glasses and their thin layers with special attention on the study of some systems based on tellurium (Ge(Ga)-Sb-Te, (Ge)-As-Te), selenium (Ge(Ga)-Sb-Se), but also other elements. The department also studied the preparation of thin chalcogenide layers from organometallic precursors. The research of amorphous chalcogenides was largely based on broad cooperation with foreign as well as domestic institutes. A significant stimulus supporting the developmental and research activities in this area was broadening of the spectral area of ellipsometric measurements including the UV-VIS-NIR part of the spectrum as well as spectrophotometers covering the UV-VIS-NIR-MIR-FIR parts of the spectrum.

The second area was the research of UV curable paints and varnishes. The study primarily focused on two areas: hybrid polymerization systems (radical and cation polymerization) and UV curable systems using UV LED. One of the promising areas in the area of curing of paints and varnishes using UV radiation is the possibility of substituting medium-pressure mercury lamps with UV LED (longer lifetime, lower electricity consumption, environmental aspects, etc.). The project TP01010012 (GAMA2-01/007) focused on the development of UV curable varnish for digital varnishing machines which will allow surface as well as partial varnishing including special effects. The varnish is cured by UV LED technology.

In the area of material printing and printed electronics, where attention was on smart packaging, smart labels for autonomous temperature and relative humidity monitoring were developed on a semi-operational level. The smart labels were tested by end users in the field of food processing, healthcare, museum administration, logistics, etc. In the area of material printing, the group focused on the issue of printing large-scale sensors for warehouse management using IoT data transfer. The technology of sensor production was successfully transferred to the production level for the specific types of sensors and the first series of sensors were manufactured and deployed. In the third year of the OrgBat project, research focused on printed accumulators based on organic compounds. This involved accumulators with electrolytes based on lithium salts as well as sodium salts. Research continued on the SmartField project which focused on printed sensors for the detection of soil moisture and temperature in various depths. The technology of sensor printing on a biodegradable (wooden) substrate was developed. This

technology was patented. Data collection from the sensors was performed by means of IoT with transition via networks such as LoRa, SigFox, etc. using a module developed as part of the project.

In collaboration with OP papírna, s.r.o. research continued on the evaluation of print-through on thin print papers. The aim was to develop a print-through testing methodology which would be readily applicable in practice and would correspond to the conditions under which thin print papers are commonly printed. All available published methods of print-through testing were checked and compared and an optimal testing methodology was proposed.

In the context of the research of thermochromic systems, the project MIT FV30048 *New additives for multifunctional modification of polymer surfaces* was completed. During the last year, research focused especially on long-term testing of the developed thermochromic coatings for high temperatures perylene pigment aggregachromy. The stability of their thermochromic behaviour was verified over longer periods of time, from the preparation of the coating to simulated sunlight exposure. The results are protected by a utility model.

The department also performed research aimed at the development of new printing forms for flexo printing. Flexo printing is currently a very promising printing technique used primarily for the development of a broad range of packaging. Research focused on two directions. The main focus was on the development of new rubber printing forms, improvement of their printing properties and methods of direct engraving using various types of lasers (in cooperation with Ligum, spol. s r.o., Gravitech, s.r.o.) The department was also involved in the implementation of new flexo printing forms in practice (Obchodní tiskárny, a.s., OTK GROUP, a.s.). This activity focused on practical applications in the polygraphic industry. The other direction focused on the application of the knowledge at the Department of Graphic Arts and Photophysics in providing technical support in the development of printed electronics and UV curable systems.

Department of Economy and Management of Chemical and Food Industry (KEMCh)

Research performed by the Department of Economy and Management of Chemical and Food Industry focused on eight economic and management areas.

In the field of marketing management, a primary qualitative research was carried out to identify the use of various online public relations tools in chemical enterprises in the CR and to evaluate their perceived effectiveness in influencing the public opinion. The department also examined the use of social media and online platforms for communication between chemical and food enterprises and the public.

In the area of shared and environmental economy, research continued on the attitudes to the alternative B2B sharing by chemical enterprises as part of the COST (CA16121) project.

In the field of circular economy, the possibilities of using waste as a source of energy were further investigated. Focus was also on environmental management tools which are currently very popular on corporate level. Using a qualitative study, the current approaches to ensuring and measuring the sustainability of chemical production were examined.

In the area of social responsibility, research continued on web-based communication of socially responsible activities carried out by chemical enterprises abroad, specifically in Norway. The assessment focused on economic, environmental, ethical, social and philanthropic activities. The use of online platforms (Meta, Instagram, Twitter, etc.) for communicating corporate social responsibility was investigated.

In the field of in-house process management and supply chain management, research studies focused on the effect of packaging on the overall sustainability of supplier-customer chains. The department focused on the mapping of environmental innovations of packaging in chemical industry enterprises, examined the circumstances of possible cooperation between businesses in packaging design as well as

identified the importance of individual environmental requirements for packaging intended for cosmetic products. Research continued on the use of servitization and the related context of a changed business model and the impact of this change on the requirements of sustainable development in the chemical industry.

In the area of the impacts of Industry 4.0 on the chemical sector, research continued on the selected elements of Industry 4.0 by means of qualitative and quantitative research studies. Focus was on the environmental approaches used in Industry 4.0 and the degree of their use in supplier-customer chains. A qualitative research study was carried out on the perception of the concepts related to Industry 4.0 in corporate practice.

In the field of HR management, focus was on the current changes in the labour market related to the COVID-19 pandemic; in the area of project management, focus was on the management of projects related to research and development of chemical products.

Department of Biological and Biochemical Sciences (KBBV)

The department has a total of four research groups all of which achieved considerable success. The results included papers in impacted journals, collaboration with national and international research or academic institutions and commercial entities. A significant OP RDE funded project called NanoBio is under way. A project entitled *Strengthening of interdisciplinary cooperation in the research of nanomaterials and their effects on living organisms* allowed long-term cooperation with partners from the Hradec Králové and Pardubice Regions, specifically the Faculty of Medicine, Charles University in Hradec Králové and University Hospital Hradec Králové. The project team also includes members from the Centre of Materials and Nanotechnologies, FChT. The overall funding of the 4-year project is over 115 million CZK (approx. 4,626 tausend EUR) and the employees of the department are the principal investigators of this significant investment project.

The Immunochemistry and Immunology Group, specifically its academic employees and doctoral degree students, were involved in several projects in 2021. The objective of the previously mentioned NanoBio project was to support cooperation between scientists of various fields and specializations, namely in the field of nanotechnology, nanomaterials and biomedicine. The project is implemented in cooperation with the University Hospital in Hradec Králové and the Faculty of Medicine of Charles University in Hradec Králové. In 2021, the team led by Prof. Bílková focused on surface modification and biofunctionalization of nanomaterials as part of this project and searched for their use in the area of new diagnostic methods, for example multiplex sensors for the detection of inflammatory biomarkers in liquid biological samples. The team worked on the verification of the sensors in clinical practice together with the group led by Prof. Kacerovský and Prof. Andrýs from the University Hospital in Hradec Králové. The team also continued to work with the department led by Prof. Maisnar and Doc. Radoch from the 4th Department of Internal Medicine – Hematology. The aim was to verify whether the presence of autoantibodies could positively affect the so-called cellular anti-tumour immunity and prolong the remission of the disease or increase the effectiveness of therapy in patients with multiple myeloma. In 2021, a microfluid analyser for viral RNA detection was successfully developed and tested on real samples in cooperation with IQ Structures. The team led by Prof. Bílková also focused on the development of methods and optimization of the reaction conditions for the preparation of nanoparticles from a biopolymeric substance – the hyaluronic acid. The aim was to validate the protocol of their preparation to control the polymerization procedure and covalent chain linkage and obtain nanoparticles differing in density, size and dispersion. The process of biofunctionalization will provide a functional system for targeted delivery of drugs called the drug delivery system. Research continued within a GA CR project carried out together with colleagues from the Department of Environment Protection, Faculty of Chemical Technology, Faculty of Science at Charles University in Prague and the Jaroslav Heyrovský Institute of Physical Chemistry of the Academy of Sciences. The project focused on the development and testing of surface modification of electrodes for electrochemical analysis of selected substances. In this project, the Immunochemistry Group analysed ergosterol as a possible indicator of food contamination by fungi. The aim was to establish a rapid screening method, compare different types of work electrodes and find the most suitable one for each application. Other molecules studied under the same project included proteinkinases and enzymes for protein phosphorylation in soluble and immobile form. Their enzyme

activity was determined by an electrochemical method. The Immunochemistry Group also cooperated with the University of Defence in Hradec Králové on a project the objective of which was the induction of anti-viral immune response by mucosal vaccination using nanoparticles. Another part of the research carried out by the team was the preparation and study of proteinkinase magnetic particles for controlled protein phosphorylation which was a part of the OP RDE project IT4Neuro(degeneration).

Research of the General and Clinical Biochemistry Group constantly focuses on the area of clinical diagnosis of cardiovascular diseases, type 2 diabetes, and adrenoleukodystrophy. Research was carried out in cooperation with the Institute of Clinical Chemistry and Pathobiology, Faculty of Medicine, University of Tübingen (Germany). The outcome was an innovated diagnostic procedure based on an analysis of plasma lipoproteins. This methodology was also used for the determination of the clinical cut-off values of the concentrations of linear fatty acids C÷20-C÷26 that cause X-adrenoleukodystrophy. This study has been carried out since 2008 and has so far included more than 2000 patients from the Department of Medical Genetics. In cooperation with the Department of Cardiology, Internal Clinic, Pardubice Regional Hospital a study was conducted on the parameters that affect the occurrence and development of atherosclerosis in the coronary arteries. Emphasis was especially on the determination of selected indicators of stability of atheromatous plaque in blood. Focus was also on the effect of stent type on the dynamics of some parameters during 24 and 48 hours after stent implantation in relation to short-term and long-term overall prognosis of the patient. Methods were introduced for the identification of selected aminoacids, oxoacids and fatty acids in breast milk. Cooperation was established with the Department of Obstetrics and Gynaecology of the Pardubice Hospital which provided samples of colostrum and breast milk. In these samples obtained by the dry spot technique, the levels of amino acids, oxoacids, fatty acids and vitamins were analysed in order to assess the nutritional value of breast milk. The indicators of oxidative stress in humans were determined. In 2021, a robust, relatively fast and sensitive method was introduced for simultaneous determination of allantoin and uric acid in blood obtained by the dry blood spot technique. The dry blood spot technique was used also for an analysis of other diagnostically significant indicators because taking a drop of blood from the finger is less invasive compared with conventional blood sampling. Moreover, the transport and storage of these samples is easier. The tests also included acetylcholinesterase biosensors. A new methodology was implemented for the determination of the inhibitory effect of selected cholinesterase biosensors, and the process of immobilization of acetylcholinesterase on the surface of a three-electrode sensor was tested. In this area, the group collaborated with the Department of Molecular Pathology and Biology, Faculty of Military Health Sciences in Hradec Králové. In cooperation with the Department of Pharmaceutical Botany and Ecology, Faculty of Pharmacy in Hradec Králové, the group tested the inhibitory effect of selected alkaloids in monocotyledonous plants against cholinesterase. In cooperation with the Department of Organic and Bioorganic Chemistry of the Faculty of Pharmacy in Hradec Králové, salicylanilide derivatives with a carbamic group, hydrazine-carboxamides and hydrazide-hydrazones were primarily tested as potential cholinesterase inhibitors. Newly synthesized substances as potential cholinesterase inhibitors were also tested in collaboration with the Regional Centre of Advanced Technologies and Materials and the Laboratory of Growth Regulators of the Faculty of Science, Palacký University Olomouc. In cooperation with all of the above mentioned departments, cholinesterase inhibitors were tested for inhibitory activity expressed as IC_{50}, type of inhibition, bonding mechanism between the inhibitor and the bonding location of the enzyme and their lipophilic properties. Methods were introduced for the determination of cholinesterase activity and the most appropriate reaction conditions were verified. In addition, the method for the determination of acetylcholinesterase activity using indoxyl acetate substrate was introduced. Methods were introduced for the identification of selected aminoacids, oxoacids and fatty acids in a dry spot of blood, sweat and breast milk. This year, cooperation also continued with the 2nd Department of Internal Medicine – Gastroenterology, University Hospital Hradec Králové concerning research on the effect of oxidative stress and lipid peroxidation on the development of Crohn's disease and colon cancer. In these patients, measurements focused on the levels of selected antioxidants and oxidative stress markers in whole blood, plasma and colon tissue. In these samples, the concentrations of selected aminoacids and fatty acids were determined in order to identify the indicators of these diseases.

The Microbiology Group focused on several research directions. Research continued in the area of Arcobacter-like bacteria. Arcobacter-like species are dreaded pathogenic bacteria. This research is quite unique in the Czech Republic and Central Europe. The aim of the research was to test the success of the identification of arcobacters based on several protocols of the polymerase chain reaction (PCR). The

results were also used to analyse the problems of some PCR protocols. In the department, a method was introduced for the first time to study the differences in restriction fragment length polymorphism between the different Arcobacter strains. The results showed the potential of the method for the identification of less known species. Currently, the pulsed-field gel electrophoresis (PFGE) methodology is being implemented for the identification and typing of Arcobacters. In the long term, attention is on the antimicrobial effects of natural extracts. Recent research focused on the monitoring of the resistance of both plankton and biofilm forms of these bacteria against clinical antibiotics. In cooperation with the Department of Analytical Chemistry of the Faculty of Chemical Technology, the analysis of the biological effects of natural essential oils and hydrolates continued with many interesting experimental and publication outcomes. Together with the Institute of Environmental and Chemical Engineering, the group focused on the technology and processes of lithotrophic immobilization and anaerobic bioremediation for the treatment and prevention of environmental damage. Attention was primarily on sulphate reducing bacteria and their ability to degrade toxic substances from industrial wastewater. In May 2020, another ZETA project entitled *Combined procedure of elimination of chloroacetanilide pesticides from contaminated water and soil* was launched. The objective is ecotoxicological evaluation of the degradation products of chloroacetanilide pesticides including alachlor, metolachlor and acetochlor. A TA CR GAMA project was implemented in collaboration with the Department of General and Inorganic Chemistry, Faculty of Chemical Technology on the development and testing of new biodegradable oligomer lactyl lactates for health-care disinfection applications. The assessment of the disinfection effects of the compounds was carried out in compliance with ČSN EN 13727+A2 which is applicable to products used in healthcare for hygienic scrubbing and washing of hands, surgical scrubbing and washing of hands, immersion disinfection of instruments and surface disinfection by wiping, spraying, deluging and other methods. The compounds with the best proven disinfection effect were simultaneously tested in an accredited laboratory. The results were used in a patent application. In the analysis of waste and surface water, research focused on isolating selected bacterial genera and identifying the degree of their resistance to antibiotics. In collaboration with the Department of Synthetic Polymers, Fibres and Textile Chemistry, Institute of Chemistry and Technology of Macromolecular Materials, Faculty of Chemical Technology, the group worked on the development of new textile materials with microbial and virucidal effect; research also focused on the study of the antimicrobial efficacy of newly developed materials based on oxidized starch and hyaluronic acid for healing of skin defects. With the Department of Analytical Chemistry, long-term cooperation continued on the assessment of the quality of bio products, specifically raw bread.

In 2021, the group also focused on the microbiological examination of vaginal smear samples of women included in the assisted reproduction programme and women without obvious problems. The aim of this examination was to compare the composition of the vaginal microbiome and the effect of its composition on conception. The inhibitory effect of newly synthesized sulphonamides on selected types of gram-positive and gram-negative clinically significant bacteria and yeast was determined. The sensitivity was measured by the microdilution culture medium technique and the resulting values of minimal inhibitory concentration were compared with the results of microorganism sensitivity to selected antibacterial drugs.

The Cytology and Physiology Group focused on the study of a wide range of research tasks associated with the use of primary human tissue cultures and cell lines. In the Tissue Culture Laboratory, which was lately equipped with new instrumentation and modern accessories thanks to involvement in many research and development projects, the group worked on the cultivation of new cancer cell lines, allowing a better *in vitro* characterization of the nephrotoxic, hepatotoxic and especially neurotoxic effects of the substances. In addition to long-term *in vitro* study of the cytotoxicity of acetanilide compounds in renal cell lines, where focus was on the monitoring of intracellular redox and changes by means of fluorescent probes and immunochemical methods, another important research task was the study of the nephrotoxic effect of $CdCl_2$. At the same time, a detailed study of the mechanisms of the neurotoxic effect of lipophilic (synthetic) and hydrophilic (bacterial) melanin was completed in 2021 as part of international cooperation. In the neuroblastoma cell line and renal cell lines affected by the selected test substances, the group studied mitochondrial activity using respirometry and fluorescent microscopy. Using advanced bioanalytical methods, an analysis of protein expression was performed. At the same time, new procedures were introduced to monitor cell lines incubated with the test substances in real time. In the Cell Culture Laboratory, further experiments were performed that focused on the evaluation of cytotoxicity and the effect of selected newly developed nanomaterials on the

proliferation and viability of primary and tumour cell lines. Other experiments focused on the evaluation of the cytotoxicity of new and potentially anticancer substances isolated from plants from the *Amaryllidaceae* family. These substances were analysed for their effect on cell behaviour (growth kinetics, adherence ability, proliferation, etc.) immediately after the effect took place and in real time. Furthermore, the biological effects of new potentially neuroprotective drugs, nanomaterials (nanoparticles, nanofibres, nanolayers) were assessed, including the development of entirely new unique methods for the evaluation of nuclear condensation, which became the basis for a high-quality publication describing this sensitive fluorescent method.

Institute of Applied Physics and Mathematics (ÚAFM)

The three research groups of the Institute of Applied Physics and Mathematics focused primarily on the following areas:

The first group dealt with the characterization of thin layers of materials mainly by spectroscopic ellipsometry. Ellipsometry was used to characterize the changes in the optical parameters of chalcogenide layers prepared by co-sputtering in order to better understand phase changes in memory media. It was also used for the characterization of SnSe layers doped with As prepared by pulsed laser exposure and a number of other materials. The method of theoretical modelling of laser-material interaction using SW Comsol was newly used. A significant part was ellipsometric characterization of thin layers of MoS_2 and WS_2 dichalcogenide topological insulators prepared by various deposition methods in the amorphous and crystalline phases. Cooperation with the Czech Academy of Sciences continued on optical characterization of ZnO nanorods implanted with gold nanoparticles. Cooperation continued with Yeungnam University (Republic of Korea) on the research of materials usable for the storage of energy prepared by atomic-layer deposition. This group continued on the research of organic semiconductors based on PEDOT:PSS.

The second group focused on the preparation and characterization of semiconductors with thermoelectric, magnetic and topological properties. In cooperation with the Institute of Physics of the Czech Academy of Sciences and the Faculty of Mathematics and Physics of Charles University, this area included the optimization of thermoelectric systems SnSe and SnS, Bi_2O_2Se, Bi_2Se_3 by means of doping and modification of natural compound stoichiometry. A great emphasis was on the association between the conveyor and magnetic properties and the defective structure. In this context, the group also focused on examining the possibilities of increasing the efficiency of thermoelectric conversion on the basis of optimizing crystal growth (defect concentration) or inducing superconductivity or magnetic arrangement in doped semiconductors. The model systems primarily included doped monocrystals SnSe, SnS, $Bi_2O_2Se_3$ or Bi_2Se_3 and Bi_2Te_3.

The third group focused on the examination of the development of polymeric nanoparticles, networks and brush structures using x-ray and synchrotron radiation. In the first case, focus was especially on size characterization and classification by nanoparticle size and shape depending on the method of preparation. The aim was to use multi-layer micellar nanoparticles to transport drugs in the organism. In the area of polymeric networks, focus was particularly on the study of the local arrangement of interpenetrating networks and its correlation with macroscopic and especially mechanical properties. In the area of brush structures, the group focused on the density and length of the chains on the wafer surfaces and their effect on the ability to prevent blood coagulation. A new direction was the study of the correlation between phase transitions of semiconducting polymers and their electrochemical properties. It appeared that the behaviour of these systems (e.g. PANI) had suitable properties for the development of supercondensators.

Joint Laboratory of Solid State Chemistry (SLChPL)

The scientific and research activity of SLChPL is divided into three areas – non-crystalline materials, crystalline materials-thermoelectrics and intercalates. The major part of the activities is based on cooperation with FChT UPCE departments and institutes and other workplaces.

As far as chalcogenides are concerned, the study of micro-formations (microlenses, microcraters) on the surface of volume glass of the Ge-Ss-S system by various CW lasers (λ = 532 and 785 nm) continued. The effect of the basic parameters (exposure time, chemical composition, radiation penetration depth, thermal properties) on these formations was examined. Radiation of λ = 532 nm caused primarily the formation of microlenses due to local thermal expansion. The largest microlenses were formed on stoichiometric glass $(GeS_2)_{66}(Sb_2S_3)_{34}$. Exposure to radiation of λ = 785 nm resulted predominantly in the formation of microcraters, accompanied with the so-called explosion of material with significant local overheating. The formation of microcraters was significant especially in materials rich in Sb_2S_3. Another system for the research of photoinduced microformations on the surface of volume chalcogenide glass was Ge-As-S. Here, the research is just at the beginning.

In the study of oxide glasses, $PbO\text{-}ZnO\text{-}P_2O_5\text{-}CoO$ glasses were characterized and laser of λ = 532 nm was used to form microlenses. The formal glass composition was $(100\text{-}x)(55PbO\text{-}10ZnO\text{-}35P_2O_5)\text{-}xCoO$, where x = 0–3.6 mol. %. The microlenses were created in two materials for x = 2 and 3.6 mol. %. This was probably due to the optimal radiation penetration depth ensuring sufficient local overheating of the material. Another beginning study focused on photoinduced changes on the surface of phosphate glasses $PbO\text{-}ZnO\text{-}P_2O_5\text{-}CuO$, where the aim was to examine the effect of various CuO concentrations on the above mentioned formations by using CW laser with a wavelength of λ = 785 nm.

The measurement of viscous glass flow using the thermomechanical analyser (TMA) continued. The TMA indenter is made of optical quality silica glass for perpendicular direct laser radiation on the sample. As part of the measurement of light-induced changes in viscous flow, further measurements were performed on $PbO\text{-}ZnO\text{-}P_2O_5$ phosphate glass (with and without CoO addition) in order to compare the effect of the absorption centre on the induced viscous flow changes. At the same time, further measurements were made using other wavelengths (for example λ = 808 nm) or different radiation intensities. To support the observed results, dilatometric measurements of chalcogenide and oxide glasses were performed on TMA, both with and without exposure. The work resulted in a publication.

In collaboration with CEITEC (Brno), ablation of $PbO\text{-}ZnO\text{-}P_2O_5\text{-}CoO$ glasses was performed using nano-second laser of λ = 532 nm. The results are being evaluated.

The Institute of Optical Materials and Technologies BAV, Sofia, Bulgaria, continued variable angle ellipsometry measurement of two steamed chalcogenide thin films in order to form an inter-layer (due to heating up and/or exposure). The interlayer was characterized. The cooperation resulted in a joint publication.

Cooperation continued with the Institute of Applied Physics and Mathematics on a thermal model for Ge-Sb-S glasses. The model allowed the description of local material heating in the exposure location and heat distribution to the surrounding area. The cooperation resulted in a joint publication.

Cooperation continued with the Institute of Applied Physics and Mathematics on other projects. Attention was on a detailed study of the effect of arsenic doping in monocrystalline SnSe ($SnAs_xSe_{1-x}$, $Sn_{1-x}As_xSe$). By means of transport measurements and especially positron annihilation spectroscopy performed at the Faculty of Mathematics and Physics of Charles University, the existence of various types of point defects (vacancies, substitution defects) was confirmed including their interaction and formation of clusters depending on the amount of dopant and type of doping. Very low arsenic concentrations (x~0.001) caused the so-called healing process during which the concentration of natural defects in the crystal decreases (especially V_{Sn} and $SnSe_2$ inclusions), the mobility of free carriers increases and their concentration decreases to below 10^{16} cm^{-3}. A high concentration of V_{Sn} or their clusters (in $Sn_{1-x}As_xSe$) allows low temperature (<500 K) applications.

In cooperation with SYNPO, a.s., the preparation and properties of layered zinc hydroxide salts with the anion of 2-phenyl-5-benzimidazolesulphonic acid and the anion of 4,4-oxybis(benzoic) acid were examined. In the case of hydroxide salts with 4,4-oxybis(benzoic) acid, three layered compounds were prepared that differed in the distance between the layers and anion content in the layer. Depending on the amount of anions in the layer, the maximum UV absorption of the material changed as well. Based on the results of the study of intercalates of double ZnAl hydroxide with 2-phenyl-5-

benzimidazolesulphonic acid, a utility model entitled *Photoprotective additive especially for coatings and embedding resins* was accepted.

In cooperation with CEMNAT and the University of Hradec Králové, various thermoanalytical methods were used to study thermal stability of biodegradable stents depending on the time of hydrolytic degradation. It was observed that in the process of soaking stents in a buffer solution, which simulated the internal environment in the human body (at 37 °C), the proportion of the crystalline phase gradually increased (degradation), resulting in changes in the mechanical properties of the material. It was confirmed that degradation was gradual and that stents, if applied in the human body, would have sufficient strength for a period guaranteed by the manufacturer.

In cooperation with the Institute of Chemistry and Technology of Macromolecular Materials, research on the surface properties of coatings based on acrylic latex continued. Attention was on studying the sensitivity of latex films to the effects of water. Various strategies were studied to increase the water resistance of latex coating films: (1) Application of the progressive polymerized emulsifier in latex synthesis by emulsion polymerization; (2) Introduction of covalent crosslinking into latex film (intra-particle vs. inter-particle); (3) Fluorinated monomer copolymerization. In the tensiometric measurements, emphasis was particularly on the determination of contact angles for water. The results increased the existing knowledge of the issue, especially in terms of water resistance of latex films with respect to the chemical structure and hydrophobicity. The cooperation resulted in a joint publication.

Cooperation with the Institute of Rock Structure and Mechanics of the Czech Academy of Sciences in the area of photoactivity of geopolymers modified by a nanoform of TiO_2 also included surface modification by a commercial nanoform of TiO_2 and a reduced form of TiO_2. In the case of the reduced form of TiO_2, a significant increase in activity in the visible area of the solar spectrum was observed. The cooperation resulted in a joint publication.

Cooperation continued with the Laboratory of General Physics Education, Faculty of Mathematics and Physics, Charles University. Another series of alloys with different methods of preparation were studied (after casting, cold rolling and hot rolling). DSC, AFM and SEM were used in an analysis of the composition and structure of the prepared alloys (with high Si content and various Zn, Cu, Mn, Sc and Zr concentrations) in order to monitor the formation of precipitates of different compositions. The cooperation resulted in a joint publication.

In cooperation with EIS Laboratory, Skjoldenaesvej 17, 4174 Jystrup, Denmark, FunGlass Centre, Alexander Dubček University of Trenčín, Slovakia and KOAnCh UPCE, the study of electric transport and dielectric relaxation in chalcogenide and oxide glasses using electric impedance spectroscopy continued.

Centre of Materials and Nanotechnologies (CEMNAT)

In 2021, CEMNAT, the youngest FChT department, successfully implemented its research, development and educational activities in material science in all areas of research (photonics, electronics and electrical engineering, renewable energy, chemically active surfaces). In the long term, CEMNAT employees have been known as outstanding experts in the area of physics and chemistry of solid materials, synthesis and deposition techniques of new materials including nanomaterials and metamaterials and modelling their structure and properties. In CEMNAT, there are currently four working groups (headed by Prof. Miroslav Vlček, Prof. Tomáš Wágner, Prof. Petr Němec and Dr. Jan Macák).

Also in 2021, CEMNAT confirmed its status of excellent infrastructure providing outstanding background for various open-access user groups. On the basis of the evaluation performed by the Ministry of Education, Youth and Sports of the Czech Republic, CEMNAT will continue, at least until 2022, to be on the Roadmap of Large Research Infrastructures.

In 2021, CEMNAT carried out a total of five research projects. In 2021, the project *High-sensitivity sensors and low-density materials based on polymeric nanocomposites NANOMAT* continued (supported by MEYS, OP RDE) aiming to develop active and passive innovative materials, specifically high-sensitivity new sensors based on polymeric nanocomposites and new low-density materials based on polymeric

nanocomposite materials for the space, aerospace and automotive industries. Research continued under the following projects: *Amorphous to crystal (3D2D) transition in van der Waals bonded chalcogenide materials* (supported by GA CR) and a bilateral project *Engineering of glass formation and photoinduced property modification of hybrid amorphous chalcogenides via controlled content of lone-pair electrons* (also supported by GA CR). These projects focused on basic research in the area of development of amorphous chalcogenide systems and the modification of their structure and properties. Two other projects were launched in 2021: (i) Synthesis of TiO_2 large-surface nanotube layers for efficient photocatalytic degradation of pollutants in the gaseous phase and viruses (supported by GA CR) and (ii) Network for research, innovation and product development on porous semiconductors and oxides (supported by EU, COST ACTION programme). The aim of the first of these two projects is the development of TiO_2 nanotube layers of large surfaces (50 cm^2 or more) using electrochemical anodization of Ti. The prepared layers will be further modified by overeating and sensitization. The activity of layers for photocatalytic decomposition of organic substances and viruses will be evaluated. The COST project will support internationalization of research in the field of porous semiconductors and oxides.

The CEMNAT staff were also significantly involved in the following project: *Strengthening of interdisciplinary cooperation in the research of nanomaterials and their effects on living organisms (NANOBIO)* (supported by MEYS, OP RDE). The purpose of the project was to build modern infrastructure for the development and characterization of newly prepared nanomaterials, their surface modification and biofunctionalization, and testing of the effect of conventional as well as newly developed nanomaterials on living organisms.

The funding of the above projects together with the funding from the development project Modernization and upgrade of CEMNAT infrastructure and from infrastructure funds of FChT, University of Pardubice allowed an upgrade of the instrumentation for the synthesis and characterization of advanced (nano)materials. A device for atomic layer deposition (ALD) and a reactor for chemical vapour deposition (CVD) reactor were purchased and the existing fluorometer was upgraded. In addition, smaller laboratory devices were purchased including a polarimeter, vacuum dryer, thermostat and sorbent unit. As a form of investment, access to the computing server for atomic level structure modelling was purchased.

In cooperation with CEMNAT, a total of 41 original papers were published in international impacted journals (average IF value = 5.06) and two chapters in foreign scientific books in 2021. A total of 26 active appearances (personal, online) were made at international conferences, 1 patent application was submitted and 2 professional seminars were organized.

The CEMNAT staff developed and experimentally tested a prototype of the sleeve filter which allows high efficiency capture of aerosol particles from the size of tens of nanometers. It is effective for all known viruses, including coronavirus, bacteria and solid aerosol particles, and is suitable for installation in classrooms, offices, waiting rooms and other spaces where people meet.

3.2 Involvement in Research and Development Programmes

Funding received in the framework of creative activity

Year	2014	2015	2016	2017	2018	2019	2020	2021
Institutional support for the development of research organizations (thousand EUR)	4,343	4,041	4,397	4,730	5,403	5,544	5,755	6,281
Research plans (thousand EUR)	-	-	-	-	-	-		-
Research centres (thousand EUR)	-	-	-	-	-	-		-
Foreign grants (thousand EUR)	236	336	478	523	390	301	193	90
Domestic grants (thousand EUR)	2,690	2,552	2,764	3,590	9,955	7,159	5,898	5,456
Student grant competition (thousand EUR)	754	694	701	712	690	722	484	499
Additional activity (thousand EUR)	*194	*103	*170	*214	*217	*207	*278	*271

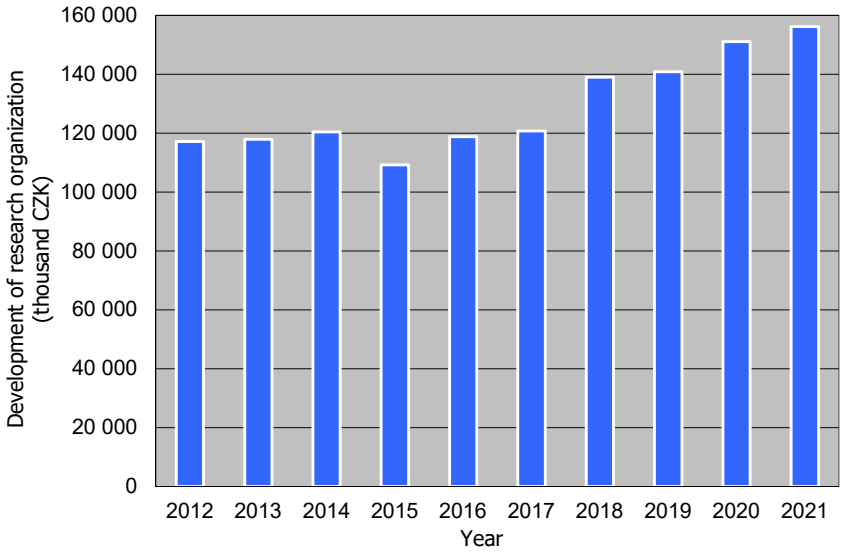
* The amount of additional activity is related to a number of activities in the framework of the main activity.

The amount of 5,456 thousand EUR obtained for domestic grants and projects in 2021 included the following:

- National educational grants and projects amounting 33 thousand EUR (IDC)
- National scientific grants and projects amounting to 3,773 thousand EUR (GA CR 1,920 thousand EUR, TA CR 663 thousand EUR, other projects 1,189 thousand EUR),
- OP RDE projects 1,650 thousand EUR.

The amount of 271 thousand EUR obtained for additional activity included the following incomes:

- Service activity 128 thousand EUR,
- Printing production 2 thousand EUR,
- Contract research 40 thousand EUR,
- Licences – inventions 101 thousand EUR.

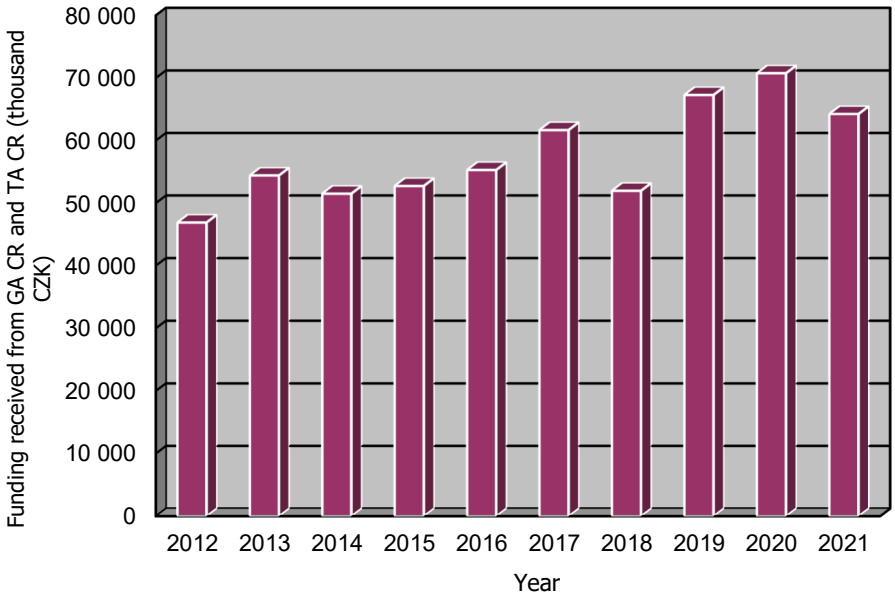


Funding by years of development of research organization

Grant funds received from GA CR and TA CR in recent years (investigators and participants)

Provider	2016		2017		2018	
	Number of implemented projects	Funding thousand EUR	Number of implemented projects	Funding thousand EUR	Number of implemented projects	Funding thousand EUR
GA CR	19	**1,306**	23	**1,466**	24	**1,491**
TA CR	15	**740**	19	**948**	17	**528**

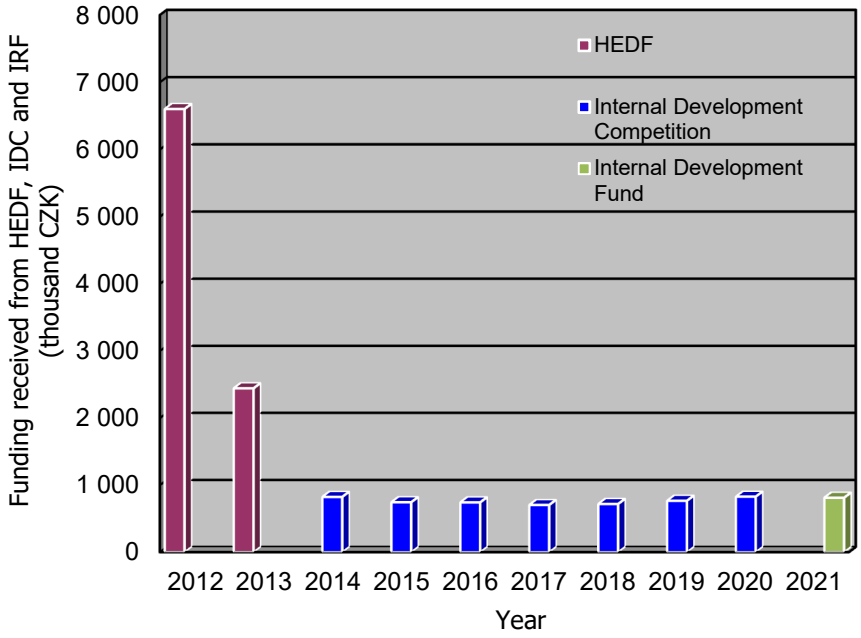
Provider	2019		2020		2021	
	Number of implemented projects	Funding thousand EUR	Number of implemented projects	Funding thousand EUR	Number of implemented projects	Funding thousand EUR
GA CR	29	**1,979**	27	**2,037**	23	**1,921**
TA CR	19	**668**	19	**658**	17	**663**
				Total in 2021	40	**2,584**



Grant funds received from GA CR and TA CR between 2012 and *2021*

Grant funds received from the Internal Development Fund

Provider	2021	
	Number of implemented projects	Funding EUR
MEYS – Internal Development Fund	1	**32,623**



Funding received from HEDF, IDC and IDF between 2012 and 2021

Involvement in the preparation and implementation of projects under EU Operational Programmes in the area of research and development

In 2021, FChT continued to implement five projects supported by the Operational Programme Research, Development and Education (referred to as OP RDE) launched the previous years.

In 2021, a total of 4 OP RDE projects were implemented (NANOBIO, NANOMAT, ORGBAT and IT4Neuro) focused on pre-application research. In two cases, FChT was the project coordinator. The NANOBIO project focused on strengthening interdisciplinary cooperation in nanomaterials research and study of their effect on living organisms. The NANOMAT project focused on the development of high-sensitivity sensors and low-density materials based on polymeric nanocomposites. Both projects involved partners from the application sphere and their purpose was to find quick use in practice. FChT continued to implement an ERDF project (PRAKTIK) focused the modernization of instrumentation in the practical courses of technical study programmes in chemistry and on the modernization of SW in theoretical and practical courses.

The projects implemented at the faculty contributed to the improvement of the quality and modernization of instrumentation of the respective departments. In 2021, the investments associated with OP RDE projects amounted to 3 million CZK (120,676 EUR).

The faculty was also actively involved in the implementation of whole-university OP RDE projects. In January 2021, FChT started the project *International mobility of researchers at the University of Pardubice II*. As a result of the project, selected research groups were joined by 5 foreign post-docs with experience from prestigious international institutions. An ESF project continued in the area of increasing the quality and modernization of education, including a greater offer of courses in English. In 2021, two additional whole-university projects continued with FChT participation focusing on improving the quality and modernization of education under the OP RDE ESF and ERDF for Higher Education Institutions II Calls. Another ongoing project that involved FChT was the whole-university project of HR development strategy at the University of Pardubice (STROP).

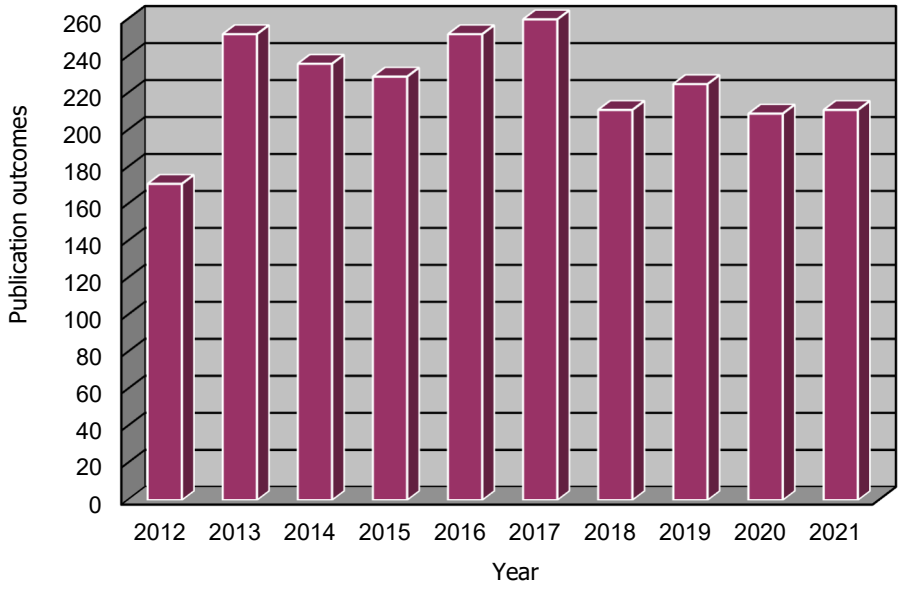
3.3 Publication Activity

The overall data on the publication activity of FChT in impacted journals between 2015 and 2021 and a detailed analysis of all publication activity of the faculty in 2021 is specified in the following tables.

Overview of the number of FChT publications in impacted journals in recent years

Year	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Number of J_{imp} publications	229	252	260	211	225	209	211

The outcomes of scientific and research activity mainly included the publication of original results in scientific and scholarly journals as well as presentation these results at conferences and symposia. The following graph shows a comparison of the most significant publication outcomes in the past ten years:



Summary of publication outcomes J_{imp} between 2012 and 2021

Overview of publication and other activity in 2021 by departments/institutes and result groups

Department	A1	A2	A3	A4	B1	B2	C	U	Total number of outcomes
KOAnCh	45	-	1	-	19	12	1	2	80
ÚOChT	28	-	-	-	9	23	-	3	63
KAlCh	35	-	5	-	23	15	1	2	81
KFCh	31	-	-	-	18	3	-	1	53
ÚEnviChI	13	-	4	-	6	21	1	4	49
ÚAFM	10	-	-	-	2	-	-	-	12
SLChPL	9	-	-	-	6	2	-	1	18
KEMCh	8	-	1	-	12	1	2	-	24
KAnT	7	-	-	1	5	15	1	1	30
ÚChTML	15	1	-	-	1	17	-	2	36
KBBV	19	-	-	1	4	11	-	2	37
KPF	11	-	-	-	3	2	-	7	24
ÚEnM	12	1	2	2	3	2	-	1	23
CEMNAT	44	-	-	-	13	6	2	1	66

Legend:

A1 Publication in a scholarly periodical listed in the WoS - J_{imp} database
A2 Publication in a scholarly periodical listed in the SCOPUS - J_{SC} database
A3 Publication in Scientific Papers proceedings
A4 Other publications Jost
B1 Papers at an international scientific conference
B2 Papers at a national scientific conference
C Monographs, selected chapters, learning texts, university textbooks
D Granted patents, utility models, open technologies, certified methodologies

3.4 Scientific Events and Conferences

8th International Conference on Chemical Technology 2021 (online)

The conference builds on the long tradition of chemical-technological conferences and its purpose is to present to the scientific community the key problems in chemistry and power engineering and to develop mutual awareness among experts, support discussion and encourage cooperation between the chemical industry and academia. The topics of the conference were especially chemical technologies and materials, energy resources and environmental technologies.

Host: Czech Society of Industrial Chemistry, Faculty of Chemical Technology
Date: 3–5 May 2021

7th Pharmacokinetic Seminar

Seminar for students and the professional public focused on dissolution and dissolution testing. Online seminar for the listeners, the speakers were present.

Host: Department of Physical Chemistry
Date: 17 June 2021

3rd MEMPUR Conference – Membrane Processes for Sustainable Development

The purpose of the conference was to introduce the issue of membrane processes from basic and applied research to real membrane applications in all areas of human activity and industrial sectors.

Host: Institute of Environmental and Chemical Engineering, Czech Membrane Platform
Date: 6–7 September 2021

22nd CSIP-PM: Conference on Special Inorganic Pigments and Powder Materials

The conference focused on the preparation and exchange of new knowledge in the area of powder materials and inorganic pigments, their application, physical and chemical properties and methods for their evaluation, environmental aspects of production, and application of inorganic pigments. The results of scientific and research activity in the area of ceramics, ceramic surface treatment and heat-resistant materials were presented.

Host: Department of Inorganic Technology
Date: 23 September 2021

12th Conference on Pigments and Binders

The Conference on Pigments and Binders is a professional event in the field of coating production, surface treatment, surface pre-treatment and other applications. It is a platform for meetings of representatives of production companies, research and development organizations, universities and businesses.

Host: Institute of Chemistry and Technology of Macromolecular Materials, Department of Paints and Organic Coatings, CHEMAGAZÍN
Date: 15–16 November 2021

4. Practical Cooperation

4.1 Practical Cooperation in Education

In the long-term, the faculty has been involved in practical cooperation with industrial enterprises through several basic activities. The same continued in 2021.

Practical cooperation in the area of education was achieved through:

- Placement of students of all forms of study in industrial enterprises and research institutions,
- Excursions of students in production enterprises, research institutions, and specialized departments,
- Student internships (mandatory internship defined by the study plan),
- Membership of experts from industry and research in the FChT Scientific Board,
- Membership of experts from industry and research in Doctoral Subject Area Boards,
- Appointment of experts from practice in State Final Examination Boards and Dissertation Committees,
- Lectures given by prominent experts from practice; this applies especially to courses in which students learn about real technological procedures and processes,
- Single lectures given by experts from practice for students of all levels of study.

In 2021, student placements in industrial enterprises took place especially in Synthesia, a.s., Pardubice and Výzkumný ústav organických syntéz, a.s., Pardubice. These placements allowed students to experience a broader spectrum of research and production processes. Students from the Department of Biological and Biochemical Sciences have their practical training in hospitals and healthcare institutions throughout the Czech Republic.

These placements increases students' chances on the labour market after completion of study.

In 2021, the departments and institutes of the Faculty of Chemical Technology organized student excursions in production plants and research and scientific institutions. The following table provides an overview of excursions carried out in 2021.

Excursions carried out in 2021

Department/institute organizing the excursion	Visited production plant, company, institution	Number of students
KOAnCh	Meduna, s.r.o., Černá za Bory	12
	Saint-Gobain ADFORS CZ, s.r.o., Litomyšl	14
	Kyocera AVX Components, s.r.o., Lanškroun	14
KAlCh	Pardubický pivovar, a.s.	15
	Bioanalytika CZ, s.r.o., Chrudim	6
ÚEnviChI	BČOV, Pardubice	14
KEMCh	Synthesia, a.s., Pardubice	9
KPF	H.R.G., s.r.o., Litomyšl	8
ÚEnM	Explosia, a.s., Pardubice	8

4.2 Practical Cooperation in Science and Research

In 2021, the activities of the following joint institutes successfully continued:

- Joint laboratory of membrane processes, MEGA, a.s., Stráž pod Ralskem and the University of Pardubice (SLMP),
- Joint laboratory of polymer analysis and assessment, SYNPO, a.s., Pardubice and the University of Pardubice, Faculty of Chemical Technology (SLAP),
- Joint institution of applied medicine, Pardubice Hospital and Faculty of Chemical Technology (SPAM).

Further continuation of active work of these joint institutes remains vital for the development of research and scientific work of the faculty departments. The institutes are systematically involved in the scientific and research activities of the faculty and in the process of education. They are equipped with adequate instrumentations, which is gradually renewed and upgraded. The SPAM joint institution successfully continues its activities, which remain focused on increasing the quality of the process of education in master's degree programmes.

The faculty also cooperated with industrial enterprises, research institutions and hospitals. It would be impossible to list all of the partners involved in various projects of the faculty departments, whether in terms of basic or applied research, implemented by means of joint teams of investigators and additional activity. Undoubtedly, this form of collaboration in addressing current problems in industrial and application practice also contributes to the scientific and research development of the faculty and its students and must be paid due attention.

In 2021, the Faculty of Chemical Technology participated in TA CR projects, projects funded by sectoral providers, and contract projects for a number of enterprises and research institutions. The following table presents an overview of joint applied research projects.

Cooperation of the Faculty with enterprises and research institutions on joint projects

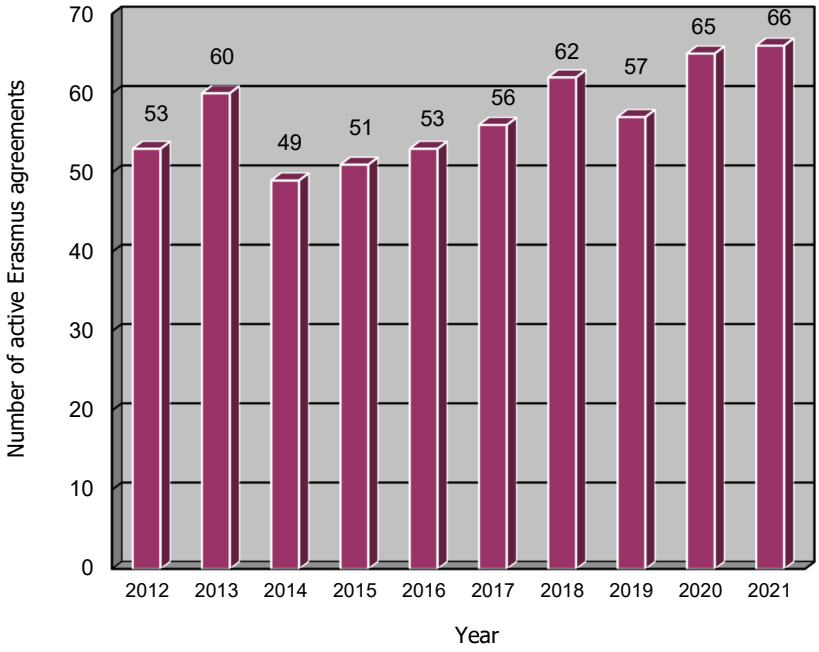
Partner firm/institution – projects funded by TA CR	Partner firm/institution – projects funded by sectoral providers
Aircraft Industries, a.s., Kunovice	Applycon, s.r.o., Dobřany
ASIO, s.r.o., Brno	Austis, a.s., Praha
Cayman Pharma, s.r.o., Neratovice	Barvy a laky TELURIA, s.r.o., Letovice
CEITEC, Brno	Bochemie, a.s., Bohumín
Centrum organické chemie, s.r.o., Pardubice	CICERO Stapro Group, s.r.o., Pardubice
COLORLAK, a.s., Staré Město	Color Spektrum, a.s., Hodonín
Contipro Pharma, a.s., Dolní Dobrouč	Český úřad pro zkoušení zbraní a střeliva, Praha
Česká membránová platforma, z.s., Česká Lípa	Ecocoal, s.r.o., Ostrava
ČVUT Praha	Explosia, a.s., Pardubice
Diamo, s. p., Stráž pod Ralskem	Explosia, a.s., Pardubice, VÚPCh
EPS biotechnology, s.r.o., Kunovice	Fakultní nemocnice (FN) Olomouc
Explosia, a.s., Pardubice	Fakultní nemocnice Hradec Králové
FOTON, s.r.o., Nová Paka	Holding Contipro, a.s., Dolní Dobrouč
Fyzikální ústav AV ČR, Praha	CHEMOTEX Děčín, a.s.
GALATEK, a.s., Ledeč nad Sázavou	Innogy Energo, s.r.o., Teplárna Náchod, Náchod
Holzbecher, s.r.o., barevna a bělidlo Zlíč	Masarykův onkologický ústav (MOÚ) Brno
Honeywell Aerospace, s.r.o., Olomouc	MEGA, a.s., Stráž pod Ralskem
INOTEX, s.r.o., Dvůr Králové nad Labem	MemBrain, s.r.o., Stráž pod Ralskem
Invaz, s.r.o., Trutnov	NOVATISK, a.s., Blansko
K2pharm, s.r.o., Opava	Pardam, s.r.o., Roudnice nad Labem
Ligum, s.r.o., Jablonec nad Nisou	Pardubická krajská nemocnice (PKN) Pardubice
KOMFI, spol. s r.o., Lanškroun	Sellier-Bellot, a.s., Vlašim
Masarykova univerzita Brno	Složky Ministerstva Vnitra ČR
MPO – Ministerstvo průmyslu a obchodu ČR	SPUR, a.s., Zlín
OTK GROUP, a.s., Kolín	Stavební chemie, a.s., Slaný
OPTAGLIO, s.r.o., Husinec-Řež	Synpo, a.s., Pardubice
PARDAM, s.r.o., Pardubice	Synthesia, a.s., Pardubice
SOMA, s.r.o., Lanškroun	ŠKODA AUTO, a.s., Mladá Boleslav
SVÚOM, s.r.o., Praha	TOSEDA, s.r.o., Staré Čívice
Synpo, a.s., Pardubice	Univerzita Karlova, Lékařská fakulta, Hradec Králové
Synthesia, a.s., Pardubice	Ústav analytické chemie AV ČR Brno
Teramed, s.r.o., Praha	Ústav makromolekulární chemie AV ČR, v.v.i., Praha
UniCRE, Unipetrol výzkumně vzdělávací centrum, a.s., Ústí nad Labem	VŠCHT Praha, Fakulta potr. a biochemické technologie
Univerzita Tomáše Bati ve Zlíně	VUT Brno
VITON, s.r.o., Veselí nad Lužnicí	Výzkumný ústav organických syntéz, a.s., Pardubice
VŠCHT Praha, Fakulta chemicko-inženýrská	Výzkumný ústav rostlinné výroby, v.v.i., Praha
VŠCHT Praha, Fakulta potr. a biochemické technologie	Výzkumný ústav stavebních hmot, a.s., Brno
VUT Brno	
Výzkumný ústav anorg. chemie, a.s., Ústí nad Labem	
Výzkumný ústav bramborářský, s.r.o., Havlíčkův Brod	
Výzkumný ústav lesního hospodářství a myslivosti, v.v.i., Opočno	
Výzkumný ústav organických syntéz, a.s., Pardubice	
Výzkumný ústav veterinárního lékařství, v.v.i., Brno	
VZLÚ, a.s., Praha-Letňany	
ZVVZ MACHINERY, a.s., Milevsko	

Partner firm/institution - contract research projects
ASIO, spol. s r.o., Brno
Austin Detonator, s.r.o., Vsetín
AVX Czech Republic, s.r.o., Lanškroun
Belmer, a.s., Litovel
BG SYS HT, s.r.o., Pardubice
BJS Czech, s.r.o., Humpolec
BOCHEMIE, a.s., Bohumín
Contipro, a.s., Dolní Dobrouč
DEZA, a.s., Valašské Meziříčí
ECO-TREND PLUS, s.r.o., Praha
EKOMOR, s.r.o., Lískovec
Ekotech ochrana ovzduší, s.r.o., Všestary
EOP Opatovice, a.s., Pardubice
Explosia, a.s., Pardubice
Fatra, a.s., Napajedla
GEOTEST, a.s., Brno
Glanzstoff Bohemia, s.r.o., Lovosice
GrapheneUP SE, Tuřany u Slaného
HE3DA, s.r.o., Praha
Huhtamaki Česká republika, a.s., Přibyslavice
Chemotex Děčín, a.s., Boletice nad Labem, Děčín
IQ Structures, s.r.o., Husineč - Řež
Innovative Senzor Technology, s.r.o., Rožnov pod Radhoštěm
KRUŽÍK, s.r.o., Kroměříž
Lachepra, s.r.o., Pardubice
Lučební závody Draslovka, a.s., Kolín
Mangan Chvaletice, s.r.o., Chvaletice
ManukaMed Ltd. Partnership, Masterton, Nový Zéland
Metrohm, s.r.o., Praha
Mondi Štětí, a.s., Štětí
MP OrganiX, s.r.o., Praha
Orkla Foods Česko a Slovensko, Jinonice
PARDAM, s.r.o., Pardubice
PLEAS, a.s., Havlíčkův Brod
PRECHEZA, a.s., Přerov
SAINT GOBAIN ADFORS CZ, s.r.o., Litomyšl
SINPOL, s.r.o., Starý Kolín
SPM – Security Paper Mill, a.s., Praha
STU v Bratislavě, FEI, Slovensko
Synpo, a.s., Pardubice
ŠKODA AUTO, a.s., Mladá Boleslav
Titan-Metalplast, s.r.o., Liberec
Tomil, s.r.o., Vysoké Mýto
Toray Textiles Central Europe, s.r.o., Prostějov
VCI Brasil Indústria Ltda., Bauru, São Paulo, Brazílie
VÚOS, a.s., Pardubice
VVUÚ, a.s., Ostrava – Radvanice
Zentiva Group, a.s., Praha

5. International Cooperation

5.1 International Cooperation in Education

An important activity in the field of international cooperation of the faculty in the area of education and science is involvement of employees and students in the ERASMUS+ and CEEPUS programmes. The total number of inter-institutional agreements in 2021 was 66. In the framework of ERASMUS+, a total of 2 teachers' mobilities took place, 2 teaching mobilities and 1 training mobility (used amount 4,441.61 EUR); 14 students' mobilities took place of total duration of 68 months (44,389,97 EUR). An overview of active agreements is shown in the figure below.



Overview of the number of active bilateral ERASMUS agreements concluded by FChT between 2012 and 2021

Involvement in Erasmus+ programme in 2021

Indicator	Erasmus 2019	Erasmus 2020	Erasmus 2021
Number of outgoing students	15	21	14
Number of incoming students	26	13	5
Number of outgoing academic employees	11	2	2
Number of incoming academic employees	3	2	0

Mobilities of students and academic staff including financial costs in 2021

	Students*			**Academic employees***		
	Number of mobilities	Student month	costs in EUR	Number of mobilities	Academic employees week	costs in EUR
Total	14	68	36,454.0	3	5	3,740.0

*) EU funding

Inter-institutional agreements with partner institutions (with some partners more than one agreement is concluded)

B	University College Arteveldehogeschool
U	Eberhard Karls Universität Tübingen
U	Friedrich-Schiller-Universität Jena
U	Technische Universität München
U	Technische Universität Chemnitz
DK	University of Southern Denmark
E	Universidad de Burgos
E	Universidad de Huelva
E	Universidad de Jaen
E	Universitat Jaume I
E	Universidad de Málaga
E	Universidad de Sevilla
E	University of the Balearic Islands
E	University of La Laguna
F	Université de Lorraine
F	Université des Sciences et Technologies de Lille I
F	Université de Rennes I
F	École Nationale Supérieure de Techniques Avancées Bretagne
G	University of West Attica (2 agreements)
G	National and Kapodistrian University of Athens
G	University of Piraeus
G	Agriculture University of Athens (2 agreements)
HR	University of Dubrovnik
HR	University of Zagreb
HU	University of Debrecen
HU	University of Dunaújváros
I	Universita Degli Studi di L'Aquilla
I	Universita Degli Studi di Modena e Reggio Emilia
I	University of Turin
LT	Kauno Kolegia
LT	Klaipeda University
LV	Riga Technical University
N	NTNU – Norwegian University of Science and Technology
NL	Hanzehogeschool Groningen
P	Universidade de Aveiro
P	University of Coimbra
P	Universidade da Madeira
P	Universidade do Minho
P	University of Viseu
PL	Akademia Górniczo-Hutnicza im. Stanisława Staszica w Krakowie
PL	Uniwersytet Łódzki
PL	Uniwersytet Mikołaja Kopernika w Toruniu
PL	Uniwersytet Marii Curie-Skłodowskiej (2 agreements)
PL	Uniwersytet Rolniczy im. Hugona Kołłątaja w Krakowie
PL	Zachodniopomorski Uniwersytet Technologiczny w Szczecinie
PL	Military University of Technology
RO	Universitatea Transilvania din Brasov
RO	Military Technical Academy of Bucharest
RO	University of Craiova
RS	University of Novi Sad
S	Umea University

SF	Abo Akademi Turku
SI	Univerza v Ljubljani (2 agreements)
SK	Technical University of Košice (2 agreements)
SK	Slovak University of Technology in Bratislava (2 agreements)
SK	Constantine the Philosopher University in Nitra
TR	Ankara University
TR	Canakkale Onsekiz Mart University
TR	Marmara University
TR	Mersin University

In 2021, the faculty was involved in three networks under the CEEPUS programme (Central European Exchange Program for University Studies); the mobilities are specified below.

Mobilities of students and academic staff including financial costs in 2021 in the CEEPUS programme

Programme	CEEPUS 2017	CEEPUS 2018	CEEPUS 2019	CEEPUS 2020	CEEPUS 2021
Number of projects	4	3	2	2	3
Number of outgoing students	1	4	0	0	0
Number of incoming students	13	6	19	4	1
Number of outgoing academic employees	2	16	5	1	0
Number of incoming academic employees	10	21	19	1	4
Funding EUR	13,465[1]	16,327[2]	17,965[3]	6,344[4]	3,741[5]

1) Of which 12,933 EUR incoming – FChT contract, 532 EUR outgoing – Rector's Office contract
2) Of which 13,913 EUR incoming – FChT contracts, 2,414 EUR outgoing – Rector's Office contract
3) Of which 16,970 EUR incoming – FChT contracts, 997 EUR outgoing – Rector's Office contract
4) Of the total allocated amount of CZK 166,513 (approx. 6,344 EUR): used 3,505 EUR – FChT contract, 2,743 EUR transferred to FChT fund, 96 EUR – Rector's Office contract
5) of the total allocated amount of 3,741 EUR: used 3,238 EUR FChT contract, 503 EUR transferred to FChT fund

In 2021, FChT had a total of three CEEPUS networks:

- CIII-CZ-0212 – Ing. Radovan Metelka, Ph.D.
- CIII-RO-1111 – Ing. Radovan Metelka, Ph.D.
- CIII-RS-0704 – Ing. Bohumil Jašúrek, Ph.D.

5.2 International Cooperation in Research and Development

The faculty is involved in research and development programmes aimed at the development of international cooperation. The faculty investigates and applies for projects funded by both domestic providers to promote bilateral cooperation and grants from international providers. In 2021, the project *New materials and processing in organic electronics (MADRAS)* successfully continued. The project is funded under Horizon 2020 – EU Framework Programme for Research and Innovation.

New materials and processing in organic electronics (MADRAS)

Under this project the faculty cooperates with 11 European partners from Spain, France, the Netherlands and Denmark under the leadership of the Eurecat Technology Centre in Spain. The project addresses the need for the development and use of new materials for the manufacture of new generation intelligent products in the area of organic and large-scale electronics.

The faculty continues solid cooperation with a number of foreign institutes. In view of the current situation and the restrictions resulting from the Covid-19 pandemic, cooperation was transformed to the

online form. Some of the planned international travels and visits of foreign teams was postponed and moved to the following year. The mobility of the employees of the faculty in the context of international cooperation required, inter alia, costs for international travel, which in 2021 amounted to **1,148 thousand CZK (46,179 EUR)**. The amount was significantly influenced by the global spread of the Covid-19 virus.

Payment of international travel (in EUR)

Year	2015	2016	2017	2018	2019	2020	2021
Costs of international travel	243,478	228,090	207,087	254,927	252,538	19,889	46,179

The structure of the sources used to cover international travel in 2021 is shown in the following table.

Sources of financing of international travel in 2021

Source of financing	Funding in EUR
Basic funding (including participation in ZG and KO), development of research organization	20,796
Specific science	5,028
Developmental projects, MEYS	0
Other main activities	0
Other science, MEYS	2,776
R+D – GA CR	6,476
R+D – Extra-budgetary grants	885
R+D – Foreign grants	0
R+D – Other types of scientific cooperation	0
OP RDE	10,218
Licence study	0
Contract research	0
Total	**46,179**

Last year, the faculty implemented programmes to support international collaboration in science and research, which significantly contributed to increasing the quality of scientific and research work. An overview of the projects is shown in following table.

International science and research collaboration projects

Project number	Investigator	Financial resources EUR	Used EUR*	Provider/Programme
EHP-BFNU-OVNKM-3-134-01-2020	Tetřevová Liběna, Doc. Ing., Ph.D.	8,367	925	Ministry of Finance/EEA and Norway grants
862492	Syrový Tomáš, Doc. Ing., Ph.D.	113,475	90,225	EU/Horizont2020
8JCH1003	Syrový Tomáš, Doc. Ing., Ph.D.	5,068	0	MEYS/Czech-Chinese Mobility Programme
LTAIN19101	Bureš Filip, Prof. Ing., Ph.D.	57,522	57,522	MEYS/Czech-Indian Mobility Programme
KA220-HED-797789EC4	Košťálová Jana, Ing., Ph.D.	2,373	The funding will be used from 2022	EU/ERASMUS+

* Due to the pandemic situation, this amount was not used in full.

A considerable share in international activities of the faculty and its departments is represented by agreements on cooperation concluded with foreign universities and institutions:

Agreements concluded between the Faculty of Chemical Technology and foreign universities and institutions

Foreign University/Institution	City	Country	Date of conclusion of agreement
Karl-Franzens Universität	Graz	Austria	1993
South Valley University	Qena, Aswan	Egypt	2001
Eberhard-Karls-Universität Tübingen	Tübingen	FRG	2004
Kemijski inštitut Ljubljana	Ljubljana	Slovenia	1994
University of Ljubljana	Ljubljana	Slovenia	1998
Technical University of Szczecin (currently West Pomeranian University of Technology)	Szczecin	Poland	1998
Technical University of Košice	Košice	Slovakia	2000
Institute of Industrial Organic Chemistry	Warsaw	Poland	2001
National Institute for Material Science	Tsukuba	Japan	2009
Kumamoto University	Kumamoto	Japan	2015
Austin Peay State University	Clarksville	USA	2013
Tennessee Tech University	Cookeville	USA	2016
Matsumoto University	Matsumoto	Japan	2006
Alexander Dubček University of Trenčín	Trenčín	Slovakia	2011

There agreements resulted in many projects supporting especially teachers' and students' mobility. In addition to agreements concluded by the faculty, there are university agreements concluded for example with the University of Rennes I, Rennes, France, Toyota Technological Institute, Nagoya, Japan, Friedrich-Schiller-Universität, Jena, Germany, Military University of Technology, Warsaw, Poland, Institute of Chemistry, Vilnius, Lithuania, Institute of Optical Materials and Technologies BAV, Sofia, Bulgaria, Nanyang Technological University, Singapore, Kyoto Prefectural University of Medicine, Kyoto, Japan, Yeungnam University, Gyeongsan, Republic of Korea, Gulbarga University, Karnataka, India, VNU-University of Sciences, Hanoi, Vietnam, Institute of Chemistry – Vietnam Academy of Science and Technology, Hanoi, Vietnam, who also cooperate with a number of departments and institutes at FChT.

6. Projects and Grants Implemented at FChT

6.1 GA CR, TA CR, IDF and Other Departmental Projects

Department of General and Inorganic Chemistry

Project number	Project title	Provider	Investigator for FChT UPCE
GA CR Projects			
18-12761S	Thermoelectric magnetic sulfides	GA CR	Kucek Vladimír, Ing., Ph.D.
19-11814S	Laser micro-patterning of the high-refractive index glasses	GA CR	Knotek Petr, Ing., Ph.D.
19-17156S	Chemistry of globular shaped hydrocarbons with boron-cage scaffolding inside the methylated sheath	GA CR	Růžičková Zdeňka, Ing., Ph.D.
20-10417S	Auto-ionizated main group cations as catalysts for ring-opening polymerization reactions	GA CR	Jambor Roman, Prof. Ing., Ph.D.
21-02964S	Nitrogen ligands for main-group elements - becoming bulkier, more conjugated and guilty	GA CR	Růžička Aleš, Prof. Ing., Ph.D.
TA CR Projects			
TH04010080	Functional dyes for security printing	TA CR	Růžička Aleš, Prof. Ing., Ph.D.
TH04010146	Polyglycerine production and its utilisation at the production of alkyds, polyesters and polyurethanes	TA CR	Růžička Aleš, Prof. Ing., Ph.D.
GAMA2-03/001	Lactic acid derivatives for disinfection applications	TA CR	Olejník Roman, Ing., Ph.D.
MIT Projects			
FV40362	Production technology for vinylchloroformate for advanced materials	MIT	Růžička Aleš, Prof. Ing., Ph.D.

Department of Economy and Management of Chemical and Food Industry

Project number	Project title	Provider	Investigator for FChT UPCE
Other projects			
EHP-BFNU-OVNKM-3-134-01-2020	Programme for exchange of best practices in social responsibility	MF	Tetřevová Liběna, Doc. Ing., Ph.D.

Department of Inorganic Technology

Project number	Project title	Provider	Investigator for FChT UPCE
MI CR Projects			
VJ01010004	The development of a strategic cluster for effective instrumental technological methods of forensic authentication of modern artworks	MI	Šulcová Petra, prof. Ing., Ph.D.

Institute of Chemistry and Technology of Macromolecular Materials

Project number	Project title	Provider	Investigator for FChT UPCE
TA CR Projects			
GAMA2-01/003	New hydrogen peroxide stabilizers	TA CR	Burgert Ladislav, Doc. Ing., CSc.
GAMA02-01/008	Driers suitable for formulations of ecologically sustainable paints based on air-drying binders	TA CR	Kalenda Petr, Prof. Ing., CSc.
GAMA2-03/002	Antimicrobial and antiviral treatment of textiles	TA CR	Bayerová Petra, Ing., Ph.D.
MIT Projects			
FV40136	Innovative increase of the utility properties and resistance of ammunition from combustible mass	MIT	Filipi Michaela, Ing., Ph.D.

Institute of Applied Physics and Mathematics

Project number	Project title	Provider	Investigator for FChT UPCE
GA CR Projects			
19-16315S	Exploration of electronic states of transition metals in tetradymites and their band structure – comparison of 3d, 4d and 5d elements	GA CR	Navrátil Jiří, Ing., CSc.
19-13659S	Interfaces between Fe-chalcogenide thin films and insulators: impact on structure, magnetism, and unconventional superconductivity	GA CR	Drašar Čestmír, Prof. Ing., Dr.

Institute of Organic Chemistry and Technology

Project number	Project title	Provider	Investigator for FChT UPCE
GA CR Projects			
19-22783S	Molecular materials: towards breaking Shockley-Queisser limit	GA CR	Imramovský Aleš, Doc. Ing., Ph.D.
TA CR Projects			
GAMA2-01/002	New wound covers for chronic wounds	TA CR	Hrdina Radim, Prof. Ing., CSc.
MIT Projects			
FV30048	New additives for multifunctional modification of polymer surfaces	MIT	Hrdina Radim, Prof. Ing., CSc.
MEYS projects			
LTAIN19101	Carbon-conjugated 2D-covalent organic frameworks based on alternative D-A-D/A-D-A systems with exceptional optoelectronic properties	MEYS	Bureš Filip, Prof. Ing., Ph.D.
OP RDE Projects			
CZ.02.1.01/0.0/0.0/16_025/0007445	Organic redox couple-based batteries for energetics of traditional and renewable resources	MEYS	Bureš Filip, Prof. Ing., Ph.D.

Department of Analytical Chemistry

Project number	Project title	Provider	Investigator for FChT UPCE
GA CR Projects			
19-03160S	Electrochemical study on new artificial enzymes and their role in sensing of neurotransmitters	GA CR	Mikysek Tomáš, Ing., Ph.D.
20-23290Y	Supercritical fluid chromatography hyphenated to mass spectrometry for the absolute quantitation of ionic and polar biomolecules	GA CR	Wolrab Denise, Dr.
21-20238S	Multidimensional chromatography – mass spectrometry quantitative workflows in detailed characterization of human plasma lipidome	GA CR	Holčapek Michal, Prof. Ing., Ph.D.
TA CR Projects			
GAMA2-01/009	Early detection of pancreatic cancer based on the lipidomic analysis of blood samples using mass spectrometry	TA CR	Holčapek Michal, Prof. Ing., Ph.D.
MI Grants			
VI20152020004	Identification of residues of improvised explosives using physico-chemical analytical methods under real conditions	MI	Ventura Karel, Prof. Ing., CSc.
MH Grants			
NU21-03-00499	Prospective study on early pancreatic cancer detection and therapy monitoring using lipidomic profiling by mass spectrometry	MH	Holčapek Michal, Prof. Ing., Ph.D.

Department of Biological and Biochemical Sciences

Project number	Project title	Provider	Investigator for FChT UPCE
GA CR Projects			
19-11867S	Research on toxicity mechanism of S-conjugates of aminophenolic drugs	GA CR	Roušar Tomáš, Doc. RNDr.,Ph.D.
TA CR Projects			
TJ02000134	Removal of polyfluorinated acids from contaminated materials using chemical degradation	TA CR	Šilha David, Ing., Ph.D.
OP RDE Projects			
CZ.02.1.01/0.0/0.0/17_048/0007421	Strengthening of interdisciplinary cooperation in the research of nanomaterials and their effects on living organisms.	MEYS	Bílková Zuzana, Prof. RNDr., Ph.D.
CZ.02.1.01/0.0/0.0/18_069/0010054	IT4Neuro	MEYS	Roušar Tomáš, Doc. RNDr., Ph.D.

Institute of Environmental and Chemical Engineering

Project number	Project title	Provider	Investigator for FChT UPCE
GACR Projects			
20-01589S	New strategies for improving sensing properties of novel electrode materials via their surface pretreatment or modification	GA CR	Šelešovská Renáta, Doc. Ing., Ph.D.
TA CR Projects			

TH03030260	Biocomposite component for slow release of active minerals in soil for plant nutrition	TA CR	Slezák Miloslav, Ing., CSc.
TJ04000226	Combined procedure of elimination of chloroacetanilide pesticides from contaminated water and soil	TA CR	Peroutková Petra, Ing.
GAMA2-01/005	Removal of dangerous compounds from contaminated waste applicable for recycling according to the circular economy	TA CR	Weidlich Tomáš, Doc. Ing., Ph.D.
GAMA2-03/006	Equipment for capturing metal ions from polluted waters by biological immobilization and possibilities for commercialization	TA CR	Palarčík Jiří, Ing., Ph.D.
GAMA2-03/009	Increasing of resistivity of textile face covers by impregnation using virucidal preparation, Part II.	TA CR	Weidlich Tomáš, Doc. Ing., Ph.D.
MIT Projects			
FV40062	Zero liquid discharge of industrial waste water using electrodialysis	MIT	Doleček Petr, Doc. Ing., CSc.

Institute of Energetic Materials

Project number	Project title	Provider	Investigator for FChT UPCE
MIT Projects			
FV40140	Perspective methods of production and testing of emulsion explosives	MIT	Pachman Jiří, Doc. Ing., Ph.D.
TA CR Projects			
TH03020263	Propellants with increased specific impulse	TA CR	Matyáš Robert, Doc. Ing., Ph.D.

Department of Physical Chemistry

Project number	Project title	Provider	Investigator for FChT UPCE
GA CR Projects			
19-00669S	The relations between activity and structure of Mg-Al/Fe mixed oxides including post-treatment for transesterification and Guerbet reaction	GA CR	Hájek Martin, Doc. Ing., Ph.D.
19-19542S	A structure-based predictive model for Brønsted acid catalyzed reactions	GA CR	Bulánek Roman, Prof. Ing., Ph.D.
19-22978S	Quantifying the basicity of reconstructed layered double hydroxides and correlating this with their performance in base-catalysed reactions	GA CR	Čapek Libor, Prof. Ing., Ph.D.
20-02183Y	Kinetic processes in chalcogenide bulks and thin films – correlation between crystal growth, viscosity and self-diffusion	GA CR	Barták Jaroslav, Ing., Ph.D.
20-12735S	Exploring zeolites with nanoscale architecture: Synergy between experiment and theory	GA CR	Bulánek Roman, Prof. Ing., Ph.D.
20-09914S	Heterojunction photocatalysts and simultaneously metal and non-metal doped TiO_2 photocatalysts for environmental photocatalytic reactions	GA CR	Čapek Libor, Prof. Ing., Ph.D.

Department of Graphic Arts and Photophysics

Project number	Project title	Provider	Investigator for FChT UPCE
GA CR Grants			
19-24516S	Chalcogenide films doped with rare-earth ions for gas sensing in the mid-infrared spectral region	GA CR	Nazabal Virginie, Doc., Dr.
TA CR Projects			
GAMA2-01/007	Development of UV curable inkjet varnish by UV LED technology	TA CR	Jašúrek Bohumil, Ing., Ph.D.
FW03010448	OILSENSE – Detection systems for industrial equipment based on large-scale sensors	TA CR	Syrový Tomáš, Doc. Ing., Ph.D.
MIT Projects			
FV30065	Research and development of the integration of telemetric and analytical processes into the management of polygraphic production and the implementation of elements of industry 4.0	MIT	Němec Petr, Prof. Ing., Ph.D.
MA Projects			
QK1810010	SMARTFIELD – Autonomous acquisition of temperature and moisture data of microclima and earth for smart farming based on platform IoT	MA	Syrový Tomáš, Doc. Ing., Ph.D.
MEYS projects			
8JCH1003	Gravure-printed ammonia sensor based on 3D RGO	MEYS	Syrový Tomáš, Doc. Ing., Ph.D.

Centre of Materials and Nanotechnologies

Project number	Project title	Provider	Investigator for FChT UPCE
GA CR Grants			
19-17997S	Amorphous to crystal (3D2D) transition in van der Waals bonded chalcogenide materials	GA CR	Krbal Miloš, Ing., Ph.D.
GC20-23392J	Engineering of glass formation and photoinduced property modification of hybrid amorphous chalcogenides via controlled content of lone-pair electrons	GA CR	Krbal Miloš, Ing., Ph.D.
21-27243S	Synthesis of TiO_2 large-surface nanotube layers for efficient photocatalytic degradation of pollutants in the gaseous phase and viruses	GA CR	Macák Jan, Dr.-Ing.
MEYS projects			
LM2018103	CEMNAT Research Infrastructure	MEYS	Vlček Miroslav, Prof. Ing., CSc.
OP RDE Projects			
CZ.02.1.01/0.0/0.0/ 17_048/0007376	High-sensitivity sensors and low-density materials based on polymeric nanocomposites-NANOMAT	MEYS	Vlček Miroslav, Prof. Ing., CSc.

Faculty projects

Project number	Project title	Provider	Investigator for FChT UPCE
OP RDE Projects			
OP RDE – PRAKTIK: CZ.02.2.67/0.0/0.0/ 16_016/0002458	Modernization of practical teaching and innovation of practical skills in technically focused study programs	MEYS	Čapek Libor, Prof. Ing., Ph.D.

Student Grant Competition (SGC) projects at FChT in 2021

Project number	Project title	Provider	Investigator for FChT UPCE
SGC FCHT 2021			
SGS_2021_001	The use of instrumental methods for the analysis of different types of matrices, including food and biological samples	UPCE	Bajerová Petra, doc. Ing., Ph.D.
SGS_2021_002	Special inorganic materials and technologies	UPCE	Koudelka Ladislav, Prof. Ing., DrSc.
SGS_2021_003	Research in significant areas of environmental engineering and management of sustainable innovations	UPCE	Mikulášek Petr, Prof. Ing., CSc.
SGS_2021_004	New organic compounds and materials – synthesis, characterization, reactivity, functional properties and safety aspects in their treatment	UPCE	Hanusek Jiří, Prof. Ing., Ph.D.
SGS_2021_005	The application of modern analytical, molecular biological, microbiological and cytological methods in laboratory diagnosis	UPCE	Kanďár Roman, Prof. Mgr., Ph.D.
SGS_2021_006	Study of new materials for chemical and pharmaceutical technology and other applications	UPCE	Košťál Petr, Ing., Ph.D.
SGS_2021_007	Synthesis, structure and study of macromolecular and supramolecular materials	UPCE	Novák Miroslav, Ing., Ph.D.

IDF projects at FChT in 2021

Project number	Project title	Provider	Investigator for FChT UPCE
Project			
IRF2021/04-FChT	Increasing the academic achievement and competences of FChT students	MEYS	Stříbrná Lucie, Mgr., Ph.D.

6.2 Involvement in Other Projects under Framework EU Programme

Department of Economy and Management of Chemical and Food Industry

Project number	Project title	Provider	Investigator for FChT UPCE
KA220-HED-797789EC4	New academic journey for EU project managers: reducing the gaps to achieve better planning and management in Europe	EU	Košťálová Jana, Ing., Ph.D.

Department of Graphic Arts and Photophysics

Project number	Project title	Provider	Investigator for FChT UPCE
862492	New materials and processing in organic electronics (MADRAS)	EU	Syrový Tomáš, Doc. Ing., Ph.D.

7. Academic Staff

This chapter specifies the number of academic staff of the faculty in recent years and at the end of 2021. For comparison, the numbers of other employees are shown as well. The tables also suggest the qualification and age structure of the faculty teachers and trends of relevant indicators.

Recalculated number of FChT employees from 2017 until the end of 2021 (each year as of 31 December)

Year	Educational staff	Scientific staff	Other staff				Total
			Technical experts,	Administration TES	Workers	Total	
2021	169.5	71.9	38.4	39.1	6.0	83.5	324.9
2020	171.5	66.2	43.4	35.0	6.0	84.4	322.1
2019	168.4	64.3	44.5	34.9	6.0	85.4	318.1
2018	168.8	54.2	43.6	34.4	6.0	84.0	307.0
2017	169.9	51.4	46.6	31.3	6.2	81.1	302.4

Qualification structure of educational staff as of 31 December of the relevant year

Working position	2017		2018		2019		2020		2021	
	F	P	F	P	F	P	F	P	F	P
Professors	40	34.1	42	36.8	40	36.1	38	34.9	38	34.6
Associate professors	45	42.3	45	41.9	47	42.4	51	45.8	46	41.5
Assistant professors	90	87.5	87	84.5	86	84.4	87	84.9	93	89.2
Assistants	9	6.0	8	5.6	9	5.5	9	5.9	7	4.2
Total	**184**	**169.9**	**182**	**168.8**	**182**	**168.8**	**185**	**171.5**	**184**	**169.5**

Note: F – physical number, P – recalculated number

Age structure of educational staff as of 31 December 2021 (number of persons)

Age	Educational staff			
	Professors	Associate professors	Assistant professors	Assistants
Younger than 29 years	-	-	4	2
30–39 years	-	1	25	2
40–49 years	7	26	42	2
50–59 years	13	8	15	-
60–69 years	11	7	7	1
Older than 70 years	7	4	-	-

Average age in the groups of academic staff in recent years

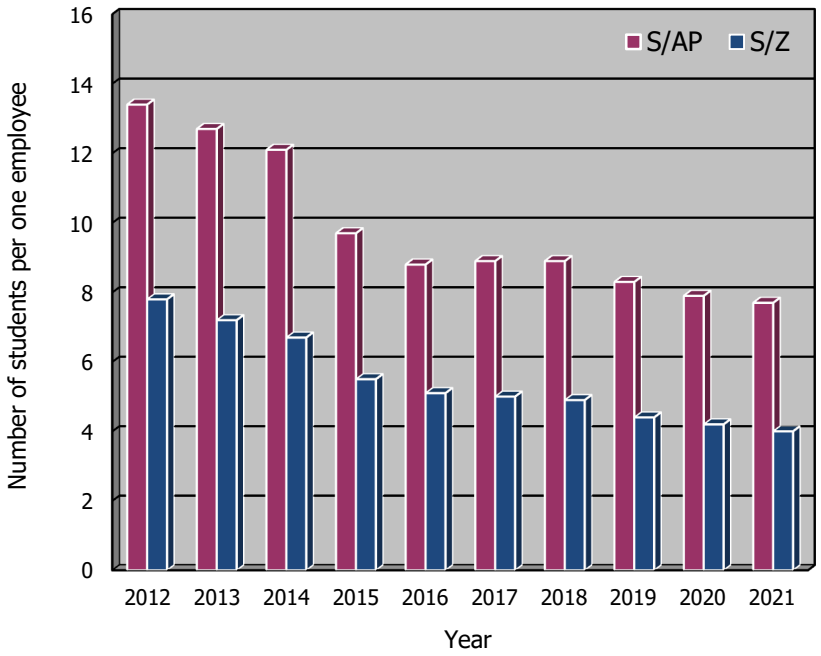
Age	Educational staff				Researchers
	Professors	Associate professors	Assistant professors	Assistants	
Average age 2017	62.2	50.8	42.5	35.6	37.3
Average age 2018	60.8	51.8	43.1	35.7	38.3
Average age 2019	61.3	52.3	43.8	36.7	38.2
Average age 2020	60.2	51.8	44.2	35.9	37.3
Average age 2021	61.2	52.7	45.1	36.9	38.9

Average age of academic staff from 2015 until the end of 2021

Year		2015	2016	2017	2018	2019	2020	2021
Average age	Educational staff	47.7	48.0	48.7	49.2	49.5	49.2	49.7
	Researchers	36.4	36.3	37.3	38.3	38.2	37.3	38.9

Number of students (S) for 1 average recalculated teacher (AP) and for 1 average recalculated employee (Z) of the Faculty

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
S/AP	13.4	12.7	12.1	9.7	8.8	8.9	8.9	8.3	7.9	7.7
S/Z	7.8	7.2	6.7	5.5	5.1	5.0	4.9	4.4	4.2	4.0



Number of students (S) per one teacher (AP) and number of students per one employee of the Faculty (Z) in recent years

Habilitation procedure and professor appointment procedure

List of areas for habilitation procedure and professor appointment procedure

Names of areas for habilitation procedure and professor appointment procedure	Validity of accreditation
Analytical chemistry	until 1 November 2023
Inorganic chemistry	until 1 November 2023
Organic chemistry	until 1 November 2023
Physical chemistry	until 1 November 2023
Chemical engineering	until 1 November 2023
Chemistry and technology of inorganic materials	until 1 November 2023
Technology of organic substances	until 1 November 2023
Surface engineering	until 31 May 2024
Environmental chemistry and engineering	until 12 November 2029

Ongoing habilitation proceedings in 2021

Surname, first name, title	Faculty	Field of expertise	Result of the procedure
Krupka Miloslav, Ing., Dr.	FChT	Technology of organic substances	in progress
Večeřa Miroslav, Ing., CSc.	FChT	Technology of macromolecular substances	in progress

Associate professors appointed in 2021

Surname, first name, title	Faculty	Field of expertise	Effect of appointment
Váňa Jiří, Ing., Ph.D.	FChT	Organic chemistry	1 November 2021

Ongoing professor appointment procedures in 2021

Surname, first name, title	Faculty	Field of expertise	Result of the procedure
Kolská Zdeňka, Doc. Ing., Ph.D.	Faculty of Science, JEPU Ústí nad Labem	Surface engineering	in progress
Imramovský Aleš, Doc. Ing., Ph.D.	FChT	Technology of organic substances	in progress
Krejčová Anna, Doc. Ing., Ph.D.	FChT	Environmental chemistry and engineering	in progress
Kubal Martin, doc. Dr. Ing.	VŠCHT Praha	Environmental chemistry and engineering	in progress
Weidlich Tomáš, Doc. Ing., Ph.D.	FChT	Environmental chemistry and engineering	in progress

8. Quality and Culture of Academic Life

In 2021, the Dean of the Faculty of Chemical Technology awarded the Silver Medal of Merit and the Memorial Medal of the Faculty of Chemical Technology to significant personalities who had contributed to the development of the faculty, its scientific and research activity and cooperation.

The Silver Medal of Merit was awarded to the following personalities:

Kvarda Jan, Dr. Ing.
for significant contribution in the field of promotion and popularization of chemistry

Slezák Miloslav, Ing. CSc.
on the occasion of a jubilee anniversary and for long-term educational an scientific activity in the field of application research

Kočvara Vladimír, Ing.
on the occasion of a jubilee anniversary and for long-term educational an scientific-research in the textile and colour chemistry

Rychtecký Jakub, Mgr.
for long-term and exemplary cooperation with the Faculty of Chemical Technology, University of Pardubice

The Memorial Medal of the Faculty of Chemical Technology was awarded to the following personalities:

Liška Marek, Prof. Ing. DrSc.
on the occasion of a jubilee anniversary

Málek Jiří, Prof. Ing. DrSc.
for publication in a journal in the first decile according to the Web of Science database

Shánělová Jana, Ing. Ph.D.
for publication in a journal in the first decile according to the Web of Science database

Košťál Petr, Ing. Ph.D.
for publication in a journal in the first decile according to the Web of Science database

Mikulášek Petr, Prof. Ing. CSc.
for publication in a journal in the first decile according to the Web of Science database

Cuhorka Jiří, Ing. Ph.D.
for publication in a journal in the first decile according to the Web of Science database

Hamplová Hana, Mgr.
for increasing students' interest in the study of chemistry

Hajdušková Jitka, Mgr.
for increasing students' interest in the study of chemistry

Čuříková Dana, Mgr.
for increasing students' interest in the study of chemistry

Academic ceremonies at FChT in 2021

On 22 October 2021, the graduation ceremony of students who completed the follow-up master's degree took place. Between 31 May and 4 June, all of these graduates took their final exams and defended their master's theses. The graduates of the follow-up master's degree received a graduation badge from the Dean of the Faculty of Chemical Technology. A total of 99 graduates were awarded.

On 23 October 2021, the ceremony of students who completed the follow-up master's degree in 2019/2020 took place. In the previous academic year, the ceremony could not take place due to the worsening epidemiological situation. The graduation ceremony was attended by 42 out of the total number of 122 graduates. The attendees received a commemorative certificate of the Faculty of Chemical Technology, University of Pardubice.

On 3 September 2021, the ceremonial pledge of graduates of bachelor's degree programmes was held. The Dean of the Faculty of Chemical Technology presented the bachelor's diploma to a total of 147 graduates who had taken their final exams and defended their bachelor's thesis between 23 and 27 August.

Regarding the worsening epidemiological situation related to Covid-19, the official matriculation of students in the first year of bachelor's degree at the Faculty of Chemical Technology did not take place.

Appreciation of FChT employees for their work in 2021

Prof. Ing. Michal Holčapek, Ph.D.
Award of the Minister of Education, Youth and Sports for outstanding results in research, experimental development and innovation in the field of natural sciences in 2021.

Prof. Ing. Petr Kalenda, CSc.
Class II Medal of the Minister of Education, Youth and Sports for educational activity, Prague, 24 August 2021.

"Significant personality of Czech Chemistry for 2021" awarded by the Board of Directors of the Association of Chemical Industry, Prague, 6 October 2021.

Class I Medal of the Faculty of Chemistry for contribution to the development of the faculty.
The medal was awarded on the occasion of 100th anniversary of the establishment of the Faculty of Chemistry at Brno University of Technology, Brno, 14 October 2021.

Prof. Ing. Petr Mikulášek, CSc.
Class I Medal of the Faculty of Chemistry for contribution to the development of the faculty.
The medal was awarded on the occasion of 100th anniversary of the establishment of the Faculty of Chemistry at Brno University of Technology, Brno, 14 October 2021.

Prof. Ing. Svatopluk Zeman, DrSc.
At the IDET 2021 Fair, Prof. Zeman received an award of merit in recognition of his contribution to the development of defence and security industry from the Minister of Defence, Defence and Security Industry Association of the Czech Republic and BVV Trade Fairs Brno.

Ing. Jan Honzíček, Ph.D.
Ing. Iva Charamzová, Ph.D.
Prof. Ing. Petr Kalenda, CSc.
Prof. Ing. Jaromír Vinklárek, Dr.
Awarded by the Rector of the University of Pardubice for beneficial cooperation with practice – commercialization of the results of research in the field of coatings. The awards were presented on the occasion of the Struggle for Freedom and Democracy Day and International Students' Day, Pardubice, 12 November 2021.

9. Activities of the Faculty and Other Affiliates

The main activities of the faculty focus on education, science and research. These activities are described in detail in Chapters 2 and 3 of this Annual Report. This section describes only those activities that support or develop the main activities of the faculty or those that provide the conditions necessary for further development of the faculty.

9.1 Publishing

An overview of university textbooks and monographs issued at FChT in 2021 is provided in Chapter 2.7 of this Annual Report. In 2021, the following proceedings were issued:

1. Scientific Papers of the University of Pardubice, Series A, Faculty of Chemical Technology, Volume 27 (2021), 78 copies.
2. Proceedings from the 23rd Conference on Special Inorganic Pigments and Powder Materials, 35 pcs CD-ROM
3. VITATOX 2021 – Proceedings, 85 copies.

In total, FChT published 3 titles, 163 copies + 35 pcs CD-ROM.

9.2 Service Departments at FChT

In 2021, the Faculty of Chemical Technology operated a number of service departments that provided their services both to the faculty and entities outside the faculty. The service departments are specified below (the abbreviations in brackets identify the institutes of the faculty where the service department is established):

- Centre of statistical analyses using SW IBM SPSS Statistics (KEMCh)
- Physical-mechanical testing laboratory for plastics, composite and textile materials (ÚChTML)
- Assessment of the properties of paper, cardboard, paperboard and cellulose (ÚChTML)
- Thermoanalytical laboratory (KAnT)
- AFM microscopy laboratory (SLChPL)
- Water analysis laboratory (ÚEnviChI)
- Centrifugal spinning laboratory (CEMNAT)
- Ecotoxicology laboratory (ÚEnviChI)
- Electron microscopy and x-ray analysis laboratory (SLChPL and KOAnCh)
- Electron microscopy, x-ray analysis, FIB and electron lithography laboratory (CEMNAT)
- Electron paramagnetic resonance laboratory (KOAnCh)
- FTIR and Raman spectroscopy laboratory (SLChPL)
- Infrared and Raman spectroscopy energetic materials laboratory (ÚEnM)
- Dispersion system analysis laboratory (ÚEnviChI)
- Pigments and powder material analysis laboratory (KAnT)
- Thermoelectric material analysis laboratory (SLChPL)
- Infrared spectroscopy laboratory (CEMNAT)

- Nuclear magnetic resonance laboratory (ÚOChT)
- Organic elemental analysis laboratory (ÚOChT)
- Powder x-ray diffractometry laboratory (KOAnCh)
- Raman and infrared spectroscopy laboratory (KOAnCh)
- X-ray diffractometry laboratory (CEMNAT)
- X-ray diffractometry of mono-crystalline materials laboratory (KOAnCh)
- X-ray photoelectron spectroscopy laboratory XPS (CEMNAT)
- Rheometry laboratory (ÚEnviChI)
- Thermal analysis laboratory (KFCh)
- Thermal analysis and optical microscopy laboratory (SLChPL)
- Measurement of temperature and thermal conductivity (ÚAFM)
- Surface and thin layer optical laboratory (ÚAFM)
- Polygraphic testing laboratory (KP)
- Thermal stability tests DTA, DSC, TGA (ÚEnM)
- Simultaneous analysis of samples using TG-GC-MS (CEMNAT)
- Micronization of samples by flow grinding (CEMNAT)
- Element analysis service (ÚEnviChI)
- Determination of electrostatic spark sensitivity (ÚEnM)
- Press services (KPF)
- Development workshops of FChT (ÚEnviChI)

10. Other Activities of FChT Staff and Students

- Involvement of the members of the academic community in the activities of university bodies, Council of Higher Education Institutions, Governmental Office for Research, Development and Innovation, National Accreditation Bureau for Higher Education,
- Active involvement of the faculty representatives in cooperation with scientific and research departments and in various professional boards, including grant commissions and in cooperation in working groups of relevant advisory bodies,
- Involvement of students and employees in various professional and interest organizations:

American Society for Mass Spectrometry,
Association for Blasting Technology and Pyrotechnics,
Association for Youth, Science and Technology AMAVET
Association of Chemical Industry of the Czech Republic,
Association of Chemical Industry of the Czech Republic,
Association of Paint Manufacturers of the Czech Republic,
Association of Polygraphic Entrepreneurs,
Association of Textile Chemists and Colourists,
Association of the Pulp and Paper Industry (ACPP), Czech Republic,
Association of the Pulp and Paper Industry, Czech Republic, Slovak Republic,
Association of Chemistry and Enviroment,
Central European Group for Separation Sciences (CEGSS),
Czech and Slovak Crystallographic Association,
Czech Anglers Union, branch Pardubice,
Czech Association of University Educators of Non-Medical Health Professions,
Czech Astronomical Society,
Czech Chemical Society, Expert Groups,
Czech Glass Society,
Czech Immunological Society,
Czech Marketing Association,
Czech Membrane Platform,
Czech Packaging Association SYBA
Czech Physiological Society,
Czech Society for Biochemistry and Molecular Biology,
Czech Society for New Materials and Technologies,
Czech Society for Nutrition,
Czech Society of Chemical Engineering,
Czech Society of Clinical Biochemistry,
Czech Society of Cosmetology,
Czech Statistical Society,
Czech Technology Platform for Sustainable Chemistry,
Czechoslovak Association for Crystal Growth,
Czechoslovak Microscopy Society,
Czechoslovak Society for Forensics Genetics,
Czechoslovak Society for Microbiology,
Department of Human Nutrition and Food Quality CAAS,
Engineering Academy of the Czech Republic,
European Chemical Society (EUCheMS),
European Defence Agency,
European Federation of Chemical Engineering, Section on Membrane Separation,
European Safety, Reliability, and Data Association (ESReDA),
European Union of Cellulose and Paper Industry (EUCEPA), EU,
Evaluation Board of Natural and Legal Entities on the Capacity to Perform
FameLab Finalists' Club, British Council Czech Republic,
Federation d'Associations de Techniciens des Industries de Peintures, Vernis, Emaux et Encres d'Imprimerie de l'Europe (FATIPEC),

Filtration Society UK,
International Adsorption Society,
International Association of Research Organizations for the Information, Media and Graphic Arts Industries (IARIGAI),
International Biographical Centre Advisory Council,
International Circle of Educational Institutes for Graphic Arts Technology and Management (IC),
International Confederation for Thermal Analysis and Calorimetry (ICTAC),
International Federation of Associations of Textile Chemists and Colourists (IFATCC),
International Humic Substances Society,
International Lipidomics Society (ILS),
International Polymer Colloids Group (IPCG),
International Pyrotechnic Society,
International Society of Electrochemistry (ISE),
International Society of Explosives Engineers,
International Zeolite Association,
Ioannes Marcus Marci Spectroscopic Society,
IPMA Czech Republic – member of the International Project Management Association
Materials Research Society (MRS), USA,
NANOPROGRESS, z.s.,
Optical Society of America (OSA), USA,
Organic Electronics Association (OE-A),
Pardubice University Choir,
Photo Club of the University of Pardubice,
Printing Association, (Flexogryphy Expert Group for the Czech and Slovak Republic, Czech Association of Scientific and Technical Societies),
Printing of Functional Applications Summer School – Swansea University,
Research, Development and Expert Opinions, Ministry of Education, Science, Research and Sport of the Slovak Republic
Slovak Association for Blasting and Drilling,
Slovak Information and Marketing Society,
Slovak Research and Development Agency
Society for Imaging Science and Technology,
Society of Applied Spectroscopy,
Students Board, University of Pardubice,
Students' Professional Activities (SPA),
Sustainable Development of Energy, Water and Environment Systems (SDEWES),
Technical Normalization Committee 142,
Technical Workgroup of the Ministry of the Environment, Waste Water and Gas Treatment,
Tesla Pardubice Sports Club,
The Comenius Academic Club,
The Electrochemical Society, Inc.,
The European Membrane Society,
The European Society of Rheology,
Union of Czech Mathematicians and Physicists, branch Pardubice,
University Sports Club, Pardubice,
University Trade Union, University of Pardubice.

- 5 major events of a scientific and educational nature and conferences organized and co-organized by the faculty departments (overview provided in Chapter 3.4),
- Participation of the faculty employees in similar events focused on education, science and research both in the Czech Republic and abroad,
- Open days for potential applicants from secondary schools, provision of information and materials concerning the admission exam (see Chapter 2.3),

- Continuation of a series of specialized seminars for secondary school chemistry teachers where developments in various areas of chemistry were presented; the programme of the course was organised in cooperation with the participants and continuation is expected in the following years,
- To allow active involvement of the university and FChT in international education, in 2021 FChT organized language courses for administrative staff of the Dean's office, departments and institutes,
- Active participation in a meeting of the managers of chemical faculties from the Czech Republic and Slovakia held on 27 September to 1 October 2021 in Velké Karlovice.

Publicity

Despite the emergency measures, the faculty continued to increase the awareness of potential applicants and the general public. In this respect, the most significant activities included participation in the traditional higher education exhibitions in the Czech Republic – Gaudeamus in Prague (online) and Gaudeamus in Brno.

A significant event in the area of publicity is presentation of the faculty in selected secondary schools. Due to the emergency measures, the representatives of the faculty could not visit grammar schools and secondary vocational school in person. In April 2021, an online presentation was organized for students of SUPŠS in Železný Brod.

On the other hand, some secondary schools visited the faculty. Secondary school students were provided with all information about the study, they had the opportunity to see the buildings and equipment, laboratories and specialized lecture rooms. In June 2021, the faculty was visited by students from SPŠCh akademika Heyrovského Ostrava.

The university organized a number of promotional events including "University of Motion", holiday visits to summer camps and day camps or special programme day camps directly at the faculty. The faculty took part in the European project Researchers' Night, the purpose of which was to support young people's interest in studying technical and natural scientific disciplines.

On a regular basis, the faculty updates the offer of various educational courses; this applies especially to licence study and data in the national electronic database. The faculty continues to organize seminars for secondary school teachers. To increase publicity and awareness, the faculty uses the internet (website, direct mail) and social networks (Facebook Instagram, YouTube). In 2021, the faculty continued to improve its website, Facebook and Instagram profiles and continued to cooperate with local influencers. The faculty presents the offer of study programmes on relevant websites.

Information about FChT events were published in dozens of press releases and media reports in Czech and Slovak newspapers and in national and regional radio broadcasting. Many current reports and articles were published in the University of Pardubice Newsletter "MY UPCE" including its electronic version.

11. Care for Students

11.1 Information and Counselling Services

In 2018, the management of the faculty continued to improve the system of providing information and counselling for students in order to facilitate their decisions concerning the selection of their future employers. The faculty published information about the demand of enterprises for graduates, regularly informed about study abroad and organized regular meetings of FChT students with the representatives of chemical enterprises called KONTAKT.
Due to the emergency measures in relation to the epidemiological situation, the fair was held online. 33 companies from different economic spheres presented their offers in an online catalogue, while 28 communicated with students via MS Teams.

11.2 Physical education, Sports and Other Activities

The long-term competition called the Flag of the Rector of the University of Pardubice is intended for students and employees of the University of Pardubice according to the instructions for various sports disciplines and lasts for a period of one academic year. The award ceremony is usually associated with the announcement of the best athletes – students of the University of Pardubice. The ceremony takes place as part of events held by the university on the Struggle for Freedom and Democracy Day.

However, in the academic year 2020/2021, the 63rd year of the Flag of the Rector did not take place due to the epidemiological situation.

One of the best athletes for the academic year 2020/2021 was an FChT student Pavla Kvasničková who ended up third in the Academic Championships of the Czech Republic in athletics.

Also in 2021, employees of the faculty were actively involved in the preparation of the "Run of the University of Pardubice" (Run of Hope) held in Pardubice on 9 October 2021.

12. Evaluation

12.1 Internal Evaluation

Internal evaluation is performed on a regular basis and involves the whole faculty and its departments and institutes. The same was performed in 2021.

Evaluation of academic staff

All of the educational staff of the faculty undergo yearly evaluation according to the following structure:

Educational activity:
- Teaching: lectures, seminars, laboratories,
- Supervision of master's and bachelor's theses, supervision of doctoral students,
- Development of teaching aids, teaching plans, laboratory tasks, building of laboratories,
- Educational activity in different institutions (faculties).

Scientific activity:
- Papers published in the previous year,
- Participation in conferences,
- Grants, technological projects, additional activity,
- International visits and travel,
- Membership in scientific and professional boards and committees.

Other activities:
- Organization activities,
- Increasing qualification,
- Other worthwhile activities.

Evaluation of excellence

In 2021, the evaluation of excellent scientific teams in basic and applied research was performed with a special focus on the following:
- Implementation of scientific projects,
- Publication activity,
- Recognition by the international community,
- Leadership of the scientific team,
- Solving scientific problems,
- Commercialization of applied research.

In all cases, emphasis was on the quality of activities taking into account the evaluation of research organizations.

Evaluation of the quality of education by students

Between May and September 2021, students evaluated the quality of education using a special module in the IS STAG system. This evaluation was organized in the context of the whole university.

Dean's Annual Reports

These Annual Reports are submitted to the Academic Senate of FChT and the academia at the beginning of each calendar year.

12.2 External Evaluation

The most significant external evaluation of the University of Pardubice and the Faculty of Chemical Technology conducted already in 2018 is undoubtedly that by the National Accreditation Bureau for Higher Education as part of our application for awarding institutional accreditation to the University of Pardubice. The Faculty of Chemical Technology was actively involved in the preparation of institutional accreditation for the following areas of education: Chemistry, Economy courses, Healthcare courses. On 7 September 2018, the decision came into force by which the University of Pardubice was awarded institutional accreditation for a period of 10 years for the following areas:
a) Educational area of Transport; bachelor's, master's and doctoral degree programme,
a) Educational area of Economy courses; bachelor's, master's and doctoral degree programme,
a) Educational area of Historical science; bachelor's, master's and doctoral degree programme,
a) Educational area of Chemistry; bachelor's, master's and doctoral degree programme,
a) Educational area of Information science; bachelor's, master's and doctoral degree programme,
a) Educational area of Healthcare courses; bachelor's, master's and master degree programme.

Institutional accreditation in the above specified educational areas at the University of Pardubice allows, through the Internal Evaluation Board (IEB), the implementation of internal processes the purpose of which is to acquire, extend or prolong the period of validity of the accreditation. The Faculty of Chemical Technology was represented in IEB by Prof. Ing. Petr Kalenda, CSc. and Doc. Ing. Jiří Cakl, CSc. (until July 2021). IEB has three scientific committees: Technical and Natural Science; Economic; and Healthcare, Humanities and Arts. In 2021, FChT was represented in the Technical and Natural Science Committee by its chairperson (Prof. Ing. Petr Kalenda, CSc.) and two of its members (Prof. Ing. Petr Mikulášek, CSc.; Prof. Ing. Petr Němec, Ph.D.). A member of the Economic Committee of IEB in 2021 was Prof. Ing. Hana Lošťáková, CSc.

Evaluation of educational activity

Following Rector's Decree No. 1/2019 concerning the Faculty Study Programme Boards, in 2021 the FChT Study Programme Board was appointed by the Dean of FChT as an authority to oversee the delivery of bachelor's and follow-up master's degree programmes accredited at FChT. The course and the quality of study in doctoral degree programmes was supervised and evaluated by Subject Area Boards appointed separately for each doctoral degree programme.

Evaluation of the results of science and research

Since 2017, a system of evaluation of research organisations and RD&I purpose-tied aid programmes according to M17+ Methodology has gradually been introduced. The methodology that RDIB uses for evaluation is specified at: http://www.vyzkum.cz/.

For the time being, the results are evaluated in the following categories:

- Module 1 – Evaluation of the quality of selected results by RDIB through Expert Panels,
- Module 2 – Evaluation of bibliometric results based on subject-specific analyses. Provided that the bibliometric result includes multiple research organizations, the result shall be awarded to each research organization in full extent.

In 2021, the results of the fourth year of M17+ implementation were published. M17 included H20 evaluation (2016 to 2019 results). The following tables provide a comparison of chemical faculties in Module 1 and Module 2. The tables are based on the results of H20.

The table below shows the evaluation of faculties with similar specializations in Module 1. The number of the results in Module 1 is influenced, inter alia, by the size of the research organization. The evaluation of the results in the H1 to H5 interval is carried out by RDIB through expert panels. H1 represents the best evaluation result. The order of the faculties reflects their evaluation quality results H1 to H3.

University – Faculty	Number of evaluated results							Proportion H1 to H3, %
	Total	H1	H2	H3	H4	H5	N	
UCT Prague – Faculty of Chemical Engineering	27	5	11	9	1	1	0	92
Charles University – Faculty of Science	97	17	47	25	5	2	1	92
Masaryk University in Brno – Faculty of Science	161	16	55	56	19	12	3	84
University of Ostrava – Faculty of Science	18	2	10	3	2	1	0	83
Palacký University Olomouc – Faculty of Science	126	21	41	39	15	9	1	80
UCT Prague – Faculty of Chemical Technology	66	7	21	21	12	5	0	74
University of Pardubice – Faculty of Chemical Technology	47	5	12	14	8	8	0	66
Brno University of Technology – Faculty of Chemistry	39	1	7	13	12	6	0	54
Tomas Bata University in Zlín – Faculty of Technology	11	0	1	1	5	4	0	18

The quality of the bibliometric results evaluated in Module 2 reflects the subject-specific classification of journals in the Q1 to Q4 quartiles. The order of the faculties reflects their publications in Q1 and Q2 journals.

University – Faculty	Bibliometric results						Proportion Q1 and Q2, %
	Total	D1	Q1	Q2	Q3	Q4	
Palacký University Olomouc – Faculty of Science	2960	415	1498	751	408	303	76
Masaryk University in Brno – Faculty of Science	2802	331	1163	883	488	268	73
Charles University - Faculty of Science	4044	561	1704	1205	705	430	72
UCT Prague – Faculty of Chemical Technology	1036	136	401	343	182	110	72
UCT Prague – Faculty of Chemical Engineering	638	41	185	264	111	78	70
Tomas Bata University in Zlín – Faculty of Technology	332	8	76	138	72	46	64
Brno University of Technology – Faculty of Chemistry	263	10	66	101	59	37	63
University of Pardubice – Faculty of Chemical Technology	950	27	202	357	259	132	59

13. Further Development of the Faculty of Chemical Technology

13.1 Investment Development of FChT

In accordance with the strategic plan, in 2021 the faculty continued to purchase new and upgraded existing instrumentation in order to support its science and research in relation to educational activity.

Details on economic management and investment development are included in the Annual Report on Economic Management of FChT for 2021. This document includes only significant investments.

Investments relating to machines, devices, equipment and software (exceeding 200 thousand CZK, approx. 8,045 EUR) in 2021

Description of machine, device, equipment or software	Department	Price (thousand CZK/EUR)
Triple quadrupole mass spectrometer (2nd instalment)	KAlCh	1,550/ 62
Liquid chromatograph for mass spectrometer AB SCIEX QTRAP 4500	KAlCh	1,548/ 62
Coater for noble metals	KAlCh	533/ 21
Pump for (U)HPLC	KAnT	328/ 13
Column thermostats for HPLC	KBBV	257/ 10
Rotary vacuum evaporator	KBBV	299/ 12
Pulsed-field gel electrophoresis	KBBV	908/ 37
Microscope with camera system	KBBV	328/ 13
Multiparameter resonance by surface plasma	KBBV	2,471/ 99
System for automatic washing and incubation of Western blots	KBBV	244/ 10
Scanner for gels and membranes	KBBV	700/ 28
Deep freezer box	KBBV	249/ 10
FT-IR gas analyser	KFCh	2,293/ 92
Thin film coating system	KFCh	425/ 17
SW for of heterogeneous catalytic reaction modelling	KFCh	392/ 16
SW for complex numerical calculations including the development of interactive materials	KFCh	220/ 9
Glove box with installed spin-coater	KOAnCh	2,100/ 84
Immersion cooling equipment for extremely low temperatures including Dewar containers	KOAnCh	280/ 11
High temperature muffle furnace	KOAnCh	263/ 11
Sample holder for FLS1000-SSS-sm photoluminescent spectrometer	KOAnCh	231/ 9
Assembly for measuring changes in optical reflectance of materials during phase change	KPF/ÚAFM	3,571/144
Upgrade of UV-VIS NIR and MIR ellipsometer	KPF	1,030/ 41
Instrument for accumulator measurement	KPF	422/ 17
Device for contact angle measurement by the sitting drop method	KPF	673/ 27
High-speed camera	ÚEnM	1,871/ 75
Instrument for the determination of electric spark sensitivity	ÚEnM	262/ 11
UV-A source for photocatalysis	ÚEnviChI	278/ 11
Upgrade of FTIR spectrometer Nicolet iS50 for Near-IR region	ÚChTML	283/11
Light chamber for ensuring standard light conditions for visual inspection	ÚChTML	265/ 11
NMR spectrometer (1st instalment)	ÚOChT/KOAnCh	6,228/251
Instrument for atomic layer deposition ALD II	CEMNAT	3,754/151
Thin layer deposition reactor	CEMNAT	2,219/ 89
Computer server	CEMNAT	388/ 16
Absorbent column	CEMNAT	313/ 13
Air conditioning	CEMNAT	523/ 21
Vacuum drier	CEMNAT	275/ 11
Modular UV-VIS spectrometer	SLChPL	684/ 28
Spin coater for thin layer preparation	SLChPL	399/ 16
Modulator for FTIR spectrometer Nicolet Nexus	SLChPL	240/ 10

In the area of TP Doubravice, FChT funded the reconstruction and modernization of two laboratories in KPF and ÚOChT; a new demonstration laboratory was constructed in the HB building. In the HB building, one of the external atria was revitalized and made available to employees and students. In cooperation with TO UPCE, the planning for the construction of the Technological Institute in TP Doubravice continued and another part of the roof of the HA building was repaired. In the main campus of the faculty, oil-free compressor components, emergency lighting batteries and outdoor lighting were also replaced. In TP Doubravice, the swinging walls of the new pressing mill and the explosive warehouse were repaired, a new roof was provided over the wastewater treatment plant and the sewer system was repaired.

13.2 Priorities of the Strategic Plan

Priority objective 1: Learner competences for the 21st century

Strategic priorities (S):
S1.1 Implementation of the study programmes at an internationally competitive level.
S1.2 Increasing the quality of the study programmes with an emphasis on the application of the acquired knowledge and skills for success on the labour market.
S1.3 Application of new technologies and modern resources for the implementation of education.
S1.4 Strengthening of the global students' competences required for success on the labour market.
S1.5 Internationalisation of the bachelor's and follow-up master's degree programmes.
S1.6 Improving the quality and internationalization of the doctoral degree programmes.
S1.7 Strengthening quality assessment of the study programmes and strategic management of educational activities.
S1.8 Broadening the offer of lifelong learning programmes.
S1.9 Inter-faculty and interdisciplinary cooperation in the context of educational activities.
S1.10 Availability of information resources.
S1.11 Ongoing care for students and systematic work with graduates.

Activities (A):
S1.1/A1 Active identification of talented secondary school students and their development by adequate means. Supporting the scientific and research activities of talented students by organizing professional competitions.
S1.1/A2 Development of cooperation with secondary schools and faculty secondary schools. Guidance of secondary school students in their scientific and research activities.
S1.1/A3 Granting scholarships to secondary school students before their enrolment based on their achievement in professional competitions organized or supported by the faculty.
S1.1/A4 Mapping and analysis of students' life cycle as part of study programme quality assessment.
S1.1/A6 Emphasis on the development of the faculty's high-quality study resources. Depending on the type and funding of study resources, making them available online free of charge with an emphasis on copyright protection and preventing their further illegal dissemination.
S1.1/A7 Supporting the faculty's activities in the area of education in order to increase the quality of the study programmes including innovative 21st century teaching methods as well as interactive teaching methods focusing on the transfer of information and knowledge from the application sphere.
S1.1/A7 Development of online forms of education. Supporting courses taught in a foreign language with an emphasis on joint participation of Czech and foreign students.
S1.1/A8 Innovation of the system of assessment of learning outcomes and academic failure. Monitoring of academic achievement. Supporting the activities that increase academic achievement. Taking adequate corrective measures including for example preparatory, compensatory and adaptation courses for first year students and additional courses to gain the required knowledge, peer learning.
S1.1/A9 Working with talented students. Supporting activities beyond academic responsibilities. Targeted support for talented students in the form of a scholarship scheme for excellent academic

achievement. Acknowledgement of exceptional achievement in scientific and creative activity. Acknowledgement of achievement in the area of internationalization, popularization and promotion.
S1.2/A1 Supporting and increasing the links between the teaching process and the application sector, especially through final theses and involvement of professionals in the teaching process. Development of systematic cooperation with external partners and future employers.
S1.2/A3 Accreditation and implementation of vocational study programmes in Chemistry and Healthcare courses.
S1.3/A2 Innovation of distance learning (for example using the LMS – Learning Management System). Training of academic staff in the key competences for online forms of education.
S1.4/A2 Emphasis on the active use of English in education as well as scientific and research activities at all levels of study (vocational courses, international mobility, final theses, active interaction with foreign students, etc.).
S1.5/A1 Delivery of follow-up master's degree programmes in English.
S1.5/A2 Final theses in English.
S1.6/A1 Reduction of academic failure in the doctoral degree programmes.
S1.6/A3 Maintaining the motivation scholarship programme system for doctoral degree students. Maintaining the system of supporting Czech applicants for the doctoral degree programmes.
S1.6/A5 Maintaining a compulsory international internship of at least one month for doctoral degree students.
S1.8/A1 Innovation of lifelong learning.
S1.10/A1 Use of information resources by the university departments. Use of university systems to prevent plagiarism.
S1.11/A1 Application of the university strategy to support students and employees with specific needs, those from socio-economically disadvantaged groups or caring parents. Elimination of technical barriers.
S1.11/A2 Application of the university methodology to recognize previous learning outcomes, provision of study information and documents to university students concerning the completion of study as part of lifelong learning or completion of study in the case of students with incomplete education.
S1.11/A3 Support for student integration and their participation in the life of the faculty.
S1.11/A4 Focus on conceptual work with graduates (including graduate websites, alumni meetings and involvement of successful graduates in the activities of the faculty, offering further education). Application of personalized services in order to facilitate the transition of graduates to the labour market.

Indicators (I):
S1.1/I1 Number of secondary schools with active cooperation.
S1.1/I2 Number of talented students supported by scholarship based on their achievement in professional competitions (number of scholarships granted/number of students enrolled).
S1.1/I3 Interest in study (number of applicants and number of students enrolled).
S1.1/I4 Number of students in accredited study programmes.
S1.1/I5 Students' outcomes in the winter semester of the first year of bachelor's degree.
S1.1/I6 Students' outcomes in the first year of all degrees.
S1.1/I7 Students' outcomes in the remaining years of all degrees.
S1.1/I8 Number of graduates. Successful completion of study within the standard period and within the standard period plus one year (n+1).
S1.1/I9 Number of students receiving merit scholarship and number of students entitled to merit scholarship.
S1.1/I10 Number of students receiving scholarship for outstanding research, development, innovation, artistic or other creative outcomes.
S1.1/I11 Number of faculty students awarded in professional competitions. Number of faculty students awarded in the area of internationalization, popularization and promotion.
S1.1/I12 Graduate unemployment by study programmes.
S1.2/I1 Number of professionals/partners from practice with an active form of collaboration (practical experiences, excursions, final theses, involvement in the teaching process).

S1.2/I2 Proportion of students in the bachelor's and follow-up master's degree programmes with a specific form of interaction with the application sphere in the course of study (practical experiences, excursions, final theses).
S1.2/I3 Number of delivered study programmes (academic and vocational) with compulsory professional experience.
S1.2/I4 Number of accredited vocational study programmes.
S1.3/I1 Number of courses using online forms or innovative teaching methods and electronic study resources.
S1.4/I1 Number of vocational courses in English.
S1.4/I2 Number of international mobilities.
S1.4/I3 Number of final theses in English in the bachelor's and follow-up master's degree programmes.
S1.5/I1 Number of delivered study programmes in English.
S1.5/I2 Number of final theses in English in the bachelor's and follow-up master's degree programmes.
S1.6/I1 Completion of the doctoral degree programme by successful defence within the standard period and within the standard period plus one year (n+1).
S1.6/I2 Proportion of doctoral degree students actively involved in projects of national or international providers.
S1.6/I3 Number of successfully defended dissertations under double supervision.
S1.6/I4 Number of successfully defended dissertations in English.
S1.6/I5 Proportion of doctoral degree students with international mobility exceeding one month.
S1.8/I1 Number of offered lifelong learning programmes.
S1.8/I2 Number of lifelong learning graduates.
S1.10/I1 Proportion of final theses checked by anti-plagiarism systems.

Priority objective 2: High-quality and respected scientific, research and creative activities

Strategic priorities (S):
S2.1 Application of the faculty assessment system of RDI quality.
S2.2 Development of high-quality or strategic scientific disciplines in which the faculty delivers its doctoral degree programmes.
S2.3 Supporting excellence in selected FORD subdisciplines.
S2.4 Strategic management of RDI and focus on international level disciplines.
S2.5 Development of modern and internationally comparable infrastructure.
S2.6 Establishing links between scientific, research and creative activities of the faculty and the application sphere with an emphasis on the commercialization of the results.
S2.7 Continued emphasis on students' involvement in scientific and research activities.
S2.8 Supporting cooperation between the faculty departments. Supporting inter-faculty cooperation.
S2.9 Strengthening the principles of open science.

Activities (A):
S2.1/A1 Strengthening the elements of strategic RDI management. Increasing the international prestige of the faculty.
S2.1/A2 Implementation of external assessment in strategic management and financial allocation.
S2.1/A3 Assessment of the quality of the results of RDI and creative activities. Identification of high-performance scientific teams.
S2.2/A1 Definition and promotion of the quality of priority disciplines, specialized disciplines and long-term unique disciplines. The identification of research priorities should reflect social demand, social relevance, national RIS3 and the achievement of higher national and international strategic objectives and measures in the area of RDI.
S2.2/A2 Supporting the preparation and increasing the quality of project applications of scientific and research projects of national and international providers. Use of the faculty and university system of providing support and advice in the process of project preparation, implementation and administration.
S2.3/A1 Definition of excellent and promising FORD subdisciplines in basic and applied research that will receive special attention and support as part of strategic management. Setting of motivation tools to support excellence.

S2.3/A2 Motivating academic and scientific employees and teams, especially those who achieve outstanding and internationally competitive RDI results in their scientific fields. Supporting prospective excellent research teams with high social benefit and long-term internationally recognized results with a significant citation rate.
S2.3/A3 Involvement of the faculty in large international research infrastructures (European Roadmap for Research Infrastructures) and supporting ERC (or equivalent) projects.
S2.4/A1 Implementation of the faculty and university strategy for funding of academic employees, researchers and teams who achieve outstanding RDI results in their scientific fields.
S2.4/A3 Implementation of the strategic system of direct funding from resources allocated to long-term conceptual development of research organizations with a direct link to RDI quality assessment.
S2.4/A4 Application of the criteria for the identification of excellent teams.
S2.4/A5 Achievement of internationally competitive research results. Development of cooperation with domestic and foreign partners in the field of basic and applied research. Involvement of the faculty in major international consortia.
S2.5/A1 Development and modernization of existing infrastructure. Upgrade of instrumentation capacities through project opportunities.
S2.6/A1 Intensification of cooperation with significant entities in the application sphere to address applied and contract research projects. Participation in regional and cross-regional structures and consortia in disciplines relevant to national RIS3 and ITI. Development of potential in industries defined by the government as strategic for the development of cluster cooperation.
S2.6/A2 More efficient use of RDI results in practice through the Centre for Technology and Knowledge Transfer. Seeking to increase income from private resources.
S2.7/A1 Establishing links between research and teaching so that all faculty departments are involved in educational activities.
S2.7/A2 Placing emphasis on permanent involvement of talented students and young researchers in national as well as international research projects.
S2.9/ A2 Raising awareness of the general and professional community, partners and application entities about the latest knowledge and scientific results as well as the social benefit of the scientific, research and creative activities of the faculty departments. Supporting openness, popularization and promotion of the results achieved in basic and applied research.

Indicators (I):
S2.2/I1 Number of submitted scientific and research projects and the amount of funding obtained from national and international projects providers.
S2.3/I1 Number of supported excellent teams.
S2.3/I2 Number of submitted and implemented ERC projects.
S2.3/I3 Number submitted and implemented projects of foreign providers.
S2.3/I4a Number and share of publications in D1 journals (according to WOS).
S2.3/I4b Number and share of selected results submitted for evaluation in Module 1 (M17+) with H1 evaluation.
S2.4/I1a Number and share of academic employees and researchers of the faculty with at least one publication in a Q1 or Q2 journal (according to WOS) per year.
S2.4/I1b Number and share of academic employees and researchers of the faculty with at least one publication in a Q1 or Q2 journal (according to WOS) per year and/or with at least one result submitted for evaluation in Module 1 (M17+) with H1 to H3 evaluation per year.
S2.4/I2 Number and share of academic employees and researchers involved in research projects of national as well as international providers.
S2.4/I3a Number of FORD subdisciplines in which the faculty will achieve the median value of publications in Q1 and Q2 journals (according to M17+) above the median value of publications in Q1 and Q2 journals (according to M17+) in the Czech Republic.
S2.4/I3b Number of FORD subdisciplines in which the faculty will achieve above-average quality indicators (Module 1 and Module 2) compared with other research organizations in the Czech Republic.
S2.4/I4a Number and share of publications in Q1 and Q1 journals (according to WOS).

S2.4/I4b Number and share of selected results submitted for evaluation in Module 1 (M17+) with H1 to H3 evaluation.
S2.4/I5 Number of citations of publications according to WOS by specialization and number of employees.
S2.4/I6 Participation of academic employees of the faculty in editorial boards of international Q1 or Q2 scientific journals (according to WOS) and elected membership in international professional societies.
S2.4/I7 Number of lectures given at the faculty by leading foreign specialists in basic research and number of lectures given at the faculty by foreign professionals from renowned companies.
S2.4/I8 Number and share of high-quality publications in Q1 and Q2 journals (according to WOS) in cooperation with other research organizations.
S2.4/I9 Number and share of high-quality publications in Q1 and Q2 journals (according to WOS) in cooperation with foreign research organizations.
S2.4/I10 Number of academic employees and researchers of the faculty actively involved in cooperation with a foreign research organization (joint publications, joint projects, invited lectures at major foreign institutions).
S2.4/I11 Number of submitted and implemented projects of national providers.
S2.5/I1 Amount of funding invested in the upgrade and modernization of infrastructure.
S2.6/I1 Number of projects and amount of funding obtained from applied and contract research, commercialization and revenues from non-pubic resources.
S2.6/I2 Number of results of applied research with an economic impact on society: Czech and foreign licensed patents, sold licences, prototypes, spin-off, etc.
S2.7/I1 Number of students actively involved in projects of national or international providers.
S2.9/I1 Number and share of RDI published as Open Access.

Priority objective 3: Human resources

Strategic priorities (S):
S3.1 Strengthening the system of employee career development including motivation to support their work activities and performance.
S3.2 Regular application of a comprehensive system of employee evaluation according to their work performance and achievements.
S3.3 Promotion of career development and employee education, adoption of knowledge, skills and key competences.
S3.4 Strengthening of the system of human resources management.

Activities (A):
S3.1/A1 Application of the principles of career development of academic employees and researchers.
S3.2/A1 Preparation of the rules for the evaluation of educational, creative, scientific, research and other activities performed by academic employees and researchers. Provision of two-way feedback between leading and regular employees.
S3.2/A2 System of remuneration of outstanding achievements in educational, scientific, research and creative activities, promotion, popularization and 'third role'.
S3.2/A3 Following the system of evaluation of academic employees and researchers, promotion of their involvement in those areas and activities in which they show strengths and contribute to the development of the faculty.
S3.3/A1 Following the university strategy, strengthening the system of employee training in the key skills (including language skills). Supporting short-term and long-term professional traineeship of the faculty employees in the Czech Republic and abroad.
S3.4/A1 Development of talented students, students in the doctoral degree programmes and young academics and researchers.
S3.4/A2 Application of the system of post-doc positions for outstanding doctoral graduates, not only from the university but also other higher education institutions including foreign ones.

Indicators (I):
S3.1/I1 Number of newly appointed associate professors and professors.
S3.1/I2 Number of independent and leading researchers.

S3.3/I1 Number of faculty employees supported in the context of training courses and overview of implemented trainings, courses and workshops.
S3.2/I1 Number of evaluated employees.
S3.3/I2 Number of defended final theses in English.
S3.4/I1 Number of post-doc positions including positions occupied by foreign citizens.

Priority objective 4: International dimension and internationalization

Strategic priorities (S):
S4.1 Development of strategic partnerships and international cooperation in education and RDI.
S4.2 Supporting student and employee mobilities.
S4.3 Implementation of attractive study programmes and courses in English.
S4.4 Strategic management of internationalization.
S4.5 Implementation of the results of quality assessment of internationalization.

Activities (A):
S4.1/A1 Strengthening and development of existing international cooperation with strategic regions and partners. Monitoring of the implementation of strategic partnerships.
S4.1/A2 Monitoring of the opportunities for new strategic international partnerships.
S4.1/A3 Deepening of internationalization through international scientific teams.
S4.3/A1 Deepening of internationalization of Czech study programmes by extending the offer of courses taught in a foreign language and by supporting final theses in a foreign language.
S4.3/A2 Exploiting the potential of foreign academic employees and researchers working at the faculty as part of the delivery of Czech and English study programmes.
S4.3/A4 Improving the quality and availability of study resources for courses in English.
S4.4/A1 Development of a bilingual internal environment.
S4.4/A3 Improving information and advisory services provided to foreign applicants.
S4.4/A4 Supporting and strengthening the integration of foreign students in the university/faculty, academic life and research teams.
S4.5/A1 Achievement of the Internationalization Action Plan by means of the faculty coordinator. Implementation of the faculty internationalization priorities.

Indicators (I):
S4.1/I1 Number of active relationships in education and RDI with foreign partners (student and employee mobility, joint publications, joint projects).
S4.1/I2 Number of active agreements on cooperation with foreign partners.
S4.1/I3 Number and structure of foreign academic employees and researchers at the faculty.
S4.1/I4 Number of organized international professional conferences/workshops.
S4.2/I1 Number of foreign mobilities of academics, researchers and administrative employees of the faculty.
S4.2/I2 Number of international mobilities of the faculty students.
S4.3/I1 Number of study programmes delivered in a foreign language.
S4.3/I2 Number of foreign students in Czech or English study programmes.
S4.3/I3 Number of courses in a foreign language and number of students enrolled.
S4.3/I5 Number of developed study resources for courses taught in English.
S4.4/I1 Number and share of students with a specific form of active use of internationalization (e.g., teaching of professional courses in a foreign language, international mobility, final thesis in a foreign language, active interaction with foreign students).

Priority objective 5: Tradition and development of the faculty

Strategies (S):
S5.1 Preserving the traditions and development of the faculty with a social impact.
S5.2 Implementation of a marketing strategy in order to develop the faculty's identity and reputation.

S5.3 Strengthening of mutual cooperation with an emphasis on synergies between the faculty departments.
S5.4 Strengthening the 'third role' of the faculty within the Czech Republic.
S5.5 21st century infrastructure.

Activities (A):
S5.1/A1 Strengthening of the elements of sustainable development, environmental protection and healthy lifestyles in all activities of the faculty. Preserving the traditional values of the faculty. Inclusion of relevant themes in educational activities.
S5.1/A2 Deepening the shared values and principles of academic self-government. Raising awareness about the role of academic bodies. Raising awareness about the events, strategic plans, legislative environment and management processes at the faculty in order to develop all creative activities and knowledge. Mutual discussions between the members of the academic community, faculty management and representatives of the academic senate.
S5.1/A3 Active acquisition of financial resources to ensure sustainable development.
S5.1/A4 Developing cooperation with local governments, specifically the City of Pardubice and the Pardubice Region.
S5.2/A1 Promotion of the faculty activities through multimedia, professional competitions, etc.
S5.2/A2 Popularization of science by organizing scientific and popular-educational events.
S5.2/A3 Use of modern information technology and social networks for internal and external communication.
S5.3/A1 Involvement of leading employees and significant personalities in the strategic management of the faculty.
S5.3/A2 Deepening of horizontal and vertical cooperation between students, employees and graduates.
S5.4/A1 Intensification of the positive effect on the general as well as the professional community in fields of study delivered at the faculty (e.g., university of the third age).
S5.5/A1 Development of modern infrastructure and facilities of the faculty for the implementation and development of high-quality education, scientific, research and creative activities as well as internationalization. Establishment of the Technology Institute in Doubravice.
S5.5/A2 Establishment of rest zones for students and employees in the premises of the faculty. Continuous improvement of the study and work environment, both indoors and outdoors.

Indicators (I):
S5.1/I1 Amount of funding received.
S5.2/I1 Number of organized popular-educational events with an impact on society as well as the general and professional community.
S5.2/I2 Number of events organized for academic members.
S5.2/I3 Number of competitions organized for elementary and secondary school students.
S5.2/I4 Number of popularization events for elementary school students.
S5.2/I5 Number of secondary schools visited.
S5.5/I1 Amount of funding invested in infrastructure including its upgrade and development.

14 Conclusion

In conclusion, I would like to thank everyone who contributed to making 2021 a special year in the life of the Faculty of Chemical Technology, University of Pardubice. I am aware that this would not have been possible without dedicated work of my closest colleagues in the management, heads of departments and institutes, academic staff, technical and economic employees, and of course students.

I hope that 2022 will be another successful year in the development of educational, scientific and research activities of the Faculty, and I wish all of the employees and students a lot of enthusiasm, good health, professional and academic achievements, and last but not least happiness in their personal life.

Prof. Ing. Petr Kalenda, CSc.
Dean

The Annual Report on the activities of the Faculty of Chemical Technology, University of Pardubice was:

- Discussed and approved at the meeting of the faculty management on 24 May 2022
- Discussed and approved by the Academic Senate of the Faculty of Chemical Technology, University of Pardubice on 31 May 2022

Annex

Significant academic events and life at the faculty

Attracting talented students and promotion of the faculty

On **16 April 2021**, the Rector of the University of Pardubice, Prof. Ing. Jiří Málek, DrSc., presented an appointment decree to Prof. Ing. Miloslav Pouzar, Ph.D.

On 3 September 2021, the Faculty of Chemical Technology held a festive academic ceremony – **Pledge of bachelor's degree graduates.**

The diploma was received by 147 new bachelors.

On 3 September 2021, outstanding students were awarded for their bachelor's theses.

The following prizes were awarded:

- Award of the Dean of the Faculty of Chemical Technology

- Pfizer ČR, s.r.o. Award

On 16 September 2020, at the beginning of the new academic year the management organized a pleasant afternoon – "**Heart 2021**".

Prof. Ing. Kalenda, CSc. and Ing. Miloslav Slezák, CSc. at the award of the Silver Commemorative Medal of Merit at the meeting of the **Scientific Board** of the Faculty of Chemical Technology on **22 September 2021**.

On **23 September 2021,** the statue made by the academic sculptor Luboš Moravec **Chemist – Atomic Scientist** was unveiled. The statue was donated to the University of Pardubice by the Municipality of Pardubice on the occasion of the 70th anniversary of the establishment of the University of Chemistry. From 1978, the sculpture was located on Palackého Street in Pardubice.

On 22 October 2021, the Faculty of Chemical Technology held a festive academic ceremony – **Graduation of follow-up master's degree students.**

The diploma
was received by 99 new engineers and masters.

On 22 October 2021, outstanding students received an award for their master's thesis and its defence.

The following prizes were awarded:

- Class I and II Rector's Student Award
- Dean's Award

- Czech Glass Society Award

- Synthesia, a.s. CEO Award

- DEVRO, s.r.o. Award

- **Miroslav Jureček Foundation** Award

- Pfizer CR, s.r.o. Award

At the same time, all graduates received a graduation badge.

On 12 November 2021, the Rector of the University of Pardubice, Prof. Ing. Jiří Málek, DrSc. **awarded scientists, academics and whole teams of students** on the occasion of the Struggle for Freedom and Democracy Day and International Students' Day.
The following scientists were awarded for their contribution: Prof. Ing. Petr Kalenda, CSc., Prof. Ing. Jaromír Vinklárek, Dr., Ing. Jan Honzíček, Ph.D. (on the photograph) and Ing. Iva Charamzová, Ph.D.

Between 19 and 21 January 2021, the Faculty of Chemical Technology was presented at the higher education and lifelong learning exhibition **Gaudeamus** in **Prague** (online) and from **23 to 26 November** also in **Brno.**

On 19 and 26 May 2021, the award ceremony of **Get the University Running! Clash of the Faculties!** took place. The cup was won by FChT with almost six thousand kilometres.

Prizes were presented to the three top runners – both students and employees.

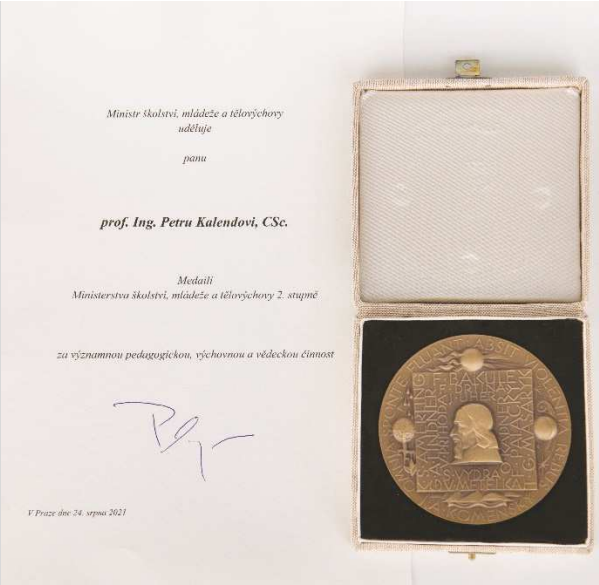
The Faculty of Chemical Technology traditionally supports the **Festival of science and technology for children and youth in the Pardubice Region – AMAVET**. This year the festival was held online. Prizes for the best students were awarded by the Dean of the Faculty, Prof. Ing. Petr Kalenda, CSc. and the Rector of the University of Pardubice, Prof. Ing. Jiří Málek, DrSc. on **10 June 2021**.

During the summer months, a series of **camps** visits took place during which children had the opportunity to meet our educational mobile teams.

Between 7 and 15 August 2021, the University of Pardubice had a permanent **Science Point** in the na Špici **sports park**, where our faculty was also represented

On **24 August 2021,** the Minister of Education, Youth and Sports, Ing. Robert Plaga, Ph.D., presented **Class II MEYS Medal** for outstanding educational activity to the Dean of the faculty Prof. Ing. Petr Kalenda, CSc. The ceremony took place in the Wallenstein Garden.

The medal is the highest award in the area of education.


Ministr školství, mládeže a tělovýchovy
uděluje

panu

prof. Ing. Petru Kalendovi, CSc.

Medaili
Ministerstva školství, mládeže a tělovýchovy 2. stupně

za významnou pedagogickou, výchovnou a vědeckou činnost

V Praze dne 24. srpna 2021

Between **6 and 9 September 2021** the traditional **get-to-know meeting** was held for new students in the White Stone Camp near lake Mácha.

On 18 September 2020, the **Children's Super Day** was held at the Pardubice Racecourse.

As part of the programme **University in Motion** (formerly *Science and technology in school yards*), we visited several grammar schools this year.

On **24 September 2021,** the Faculty participated in the European Science Festival – **Researchers' Night.**

A laboratory day tailored for elementary schools entitled In Motion prepared by the team of the Faculty of Chemical Technology for children in grades one to six in DDM BETA.

On **3 December 2021**, the regional round of the **Chemical Olympiad** was held for Category A for the Pardubice Region and Hradec Králové Regions.