



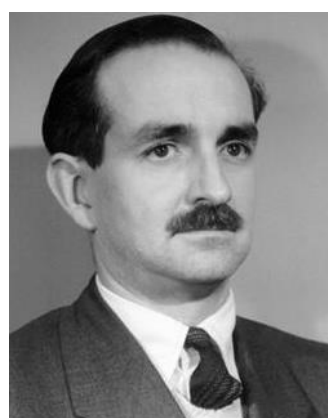
Institute of Chemical Process Fundamentals of the CAS, v. v. i.



History of the Institute



Vladimír Bažant



George Standart



Eduard Hála

- 1960 – Established in the Czechoslovak Academy of Sciences from *Department of Chemical Technology* (Prof. Vladimír Bažant, organosilicon compounds and heterogeneous catalysis) and *Department of Chemical Engineering* (Prof. George Standart, distillation and extraction processes)
- 1964 – Group of Thermodynamics and Phase Equilibria (Prof. Eduard Hála), a new campus in the northwestern suburbs of Prague (330 employees)
- 1989 – Several reorganizations (170 employees)
- 2007 – The status of the institute was changed to a “public research institution (v. v. i.)”



ICPF basic facts

Human Resources

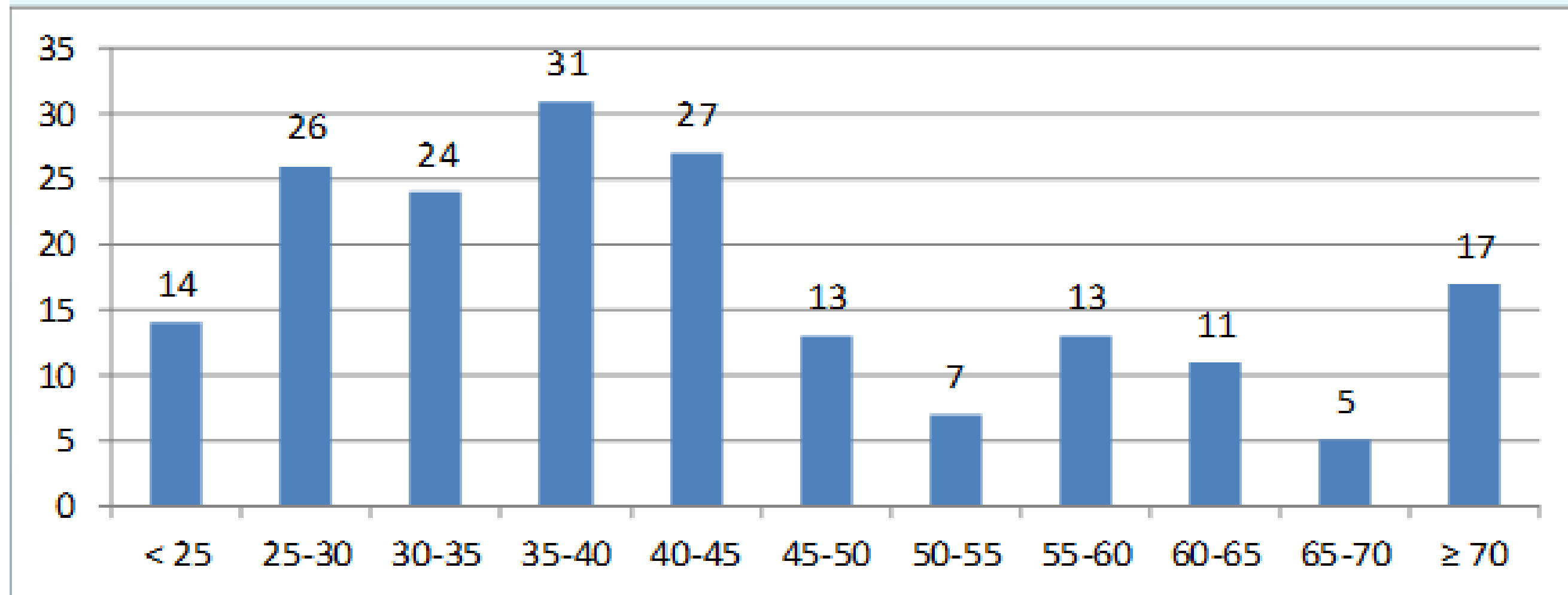
Employee	Number	FTE
PhD Students	31	22.3
Postdocs	12	10.7
Researchers	82	64.8
Engineers / Technicians	48	38.0
Supports	29	27.4
Total	202	163.2

FTE = full time equivalent

ICPF basic facts

Age structure of employees

Age category	< 25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70	≥ 70
Number of members	14	26	24	31	27	13	7	13	11	5	17



ICPF basic facts

Gender and non-Czech citizens structure of employees

Employees	Women	Men	non-Czech citizens
Researchers	31 (38 %)	51 (62 %)	10 (12 %)
Postdoc + PhD Students	12 (28 %)	31 (72 %)	10 (23 %)
Others	35 (45 %)	42 (55 %)	6 (8 %)
Total	78 (39 %)	124 (61 %)	26 (13 %)



ICPF basic facts



Budget 2019

Resources	Million EUR
Institutional funding	3.644 (48 %)
National projects and R&D Funds	3.069 (40 %)
International projects and R&D Funds	0.175 (2 %)
European Structural and Investment Funds	0.373 (5 %)
IP commercialization	0.045 (1 %)
Private (sales, services, etc.)	0.307 (4 %)
Total	7.613 (100 %)

ICPF basic facts



National projects and R&D Funds (2015-2019)

- **GACR (Czech Science Foundation) – 45 projects**
(35 Standard, 5 Junior, 3 Inter, 1 Postdoc, 1 Excellence)
- **TACR (Technology Agency of the Czech Republic) – 33 projects (4 Competence Centers)**
- **MEYS (Ministry of Education, Youth and Sports) – 20 projects**
- **MIT (Ministry of Industry and Trade) – 9 projects**
- **MA (Ministry of Agriculture) – 2 projects**
- **MC (Ministry of Culture) – 2 projects**
- **MI (Ministry of the Interior) – 1 project**
- **ME (Ministry of Environment) – 1 project**

- **Strategy AV21 (Czech Academy of Sciences) – 4 projects**
(Efficient Energy Conversion and Storage, Foods for the Future, Water for life, and Natural Hazards)

ICPF basic facts



International projects and R&D Funds (2015-2019)

- **EC (European Commission, H2020) – 6 projects**
 - **HEXACOMM** (Human Exposure to Aerosol Contaminants in Modern Microenvironments)
 - **IMEDIATE** (Innovative autoMotive MEa Development - implementation of Iphe-genie Achievements Targeted at Excellence)
 - **MEGAPlus** (Unconventional MEthane Production from Deep European Coal Seams through combined Coal Bed Methane and Underground Coal GAsification technologies)
 - **PRINTCR3DIT** (Process Intensification through Adaptable Catalytic Reactors made by 3D Printing)
 - **ShaleXenvironment** (Maximizing the EU shale gas potential by minimizing its environmental footprint)
 - **VIMMP** (Virtual materials market place)
 - **ACTRIS-2, ACTRIS PPP, ACTRIS IMP** (Aerosols, Clouds and Trace Gases Research Infrastructure) -> **ACTRIS ERIC** in 2021
- **NATO (Science for Peace and Security Program) – 3 projects** (heavy metals and radionuclides removal from water, sensors based on graphene)
- **US ARL (US Army Research Laboratory) – 1 project** (modelling of energetic materials)
- **COST Action – 7 projects**
- **MOBILITY – 3 projects**

Participation in large collaborations – ACTRIS on ESFRI Roadmap since 2016



ACTRIS is a pan-European research infrastructure producing high-quality data and information on short-lived atmospheric constituents and on the processes leading to the variability of these constituents in natural and controlled atmospheres.

The primary goals of ACTRIS are to produce high quality integrated datasets and provide services, including access to instrumented platforms, tailored for scientific and technological usage.

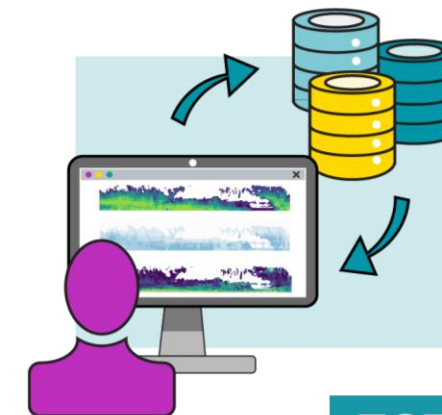


EXPLORING THE ATMOSPHERE

Long-term measurements of aerosol, clouds and trace gases are collected from surface to the stratosphere by state-of-the-art in situ and remote sensing techniques.

ENSURING QUALITY DATA

High-class and quality assured data are generated by following harmonized and standardized operating procedures and fulfilling the FAIR data principles.

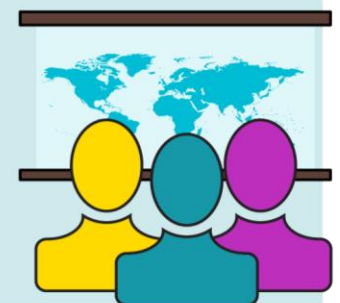


EASILY ACCESSING DATA

ACTRIS is committed to provide users free and open access to primary data and data products through a single point of entry.

ESTABLISHING OPPORTUNITIES

ACTRIS provides access to the best atmospheric research environments and expertise, promotes international collaborations and supports training of researchers and early-career scientists.



ICPF basic facts

European Structural and Investment Funds (ESIF)

- **Program - Science, Research and Education**
 - **ACTRIS-CZ RI, ACTRIS-CZ RI2** - supports the further development of the **ACTRIS-CZ**, the Czech national hub of the pan-European research infrastructure **ACTRIS ESFRI**, deals with research and long-term monitoring of chemical and physical processes in the **Atmosphere**, included in the Roadmap of Large Research Infrastructures of the Czech Republic, **ACTRIS plans to become ERIC in 2021**
 - **ICPF Mobility** - international mobility of junior researchers from the Institute
 - **Strategic partnership for environmental technologies and energy production** - solving the problem chemical processes, energy, mechanical engineering, and biotechnology
- **Program - Environment**
 - **MOSKAL** - extension and modernization of air quality monitoring methods by measuring the size distribution of aerosol particles and their optical properties



ICPF basic facts

IP commercialization (2015-2019)

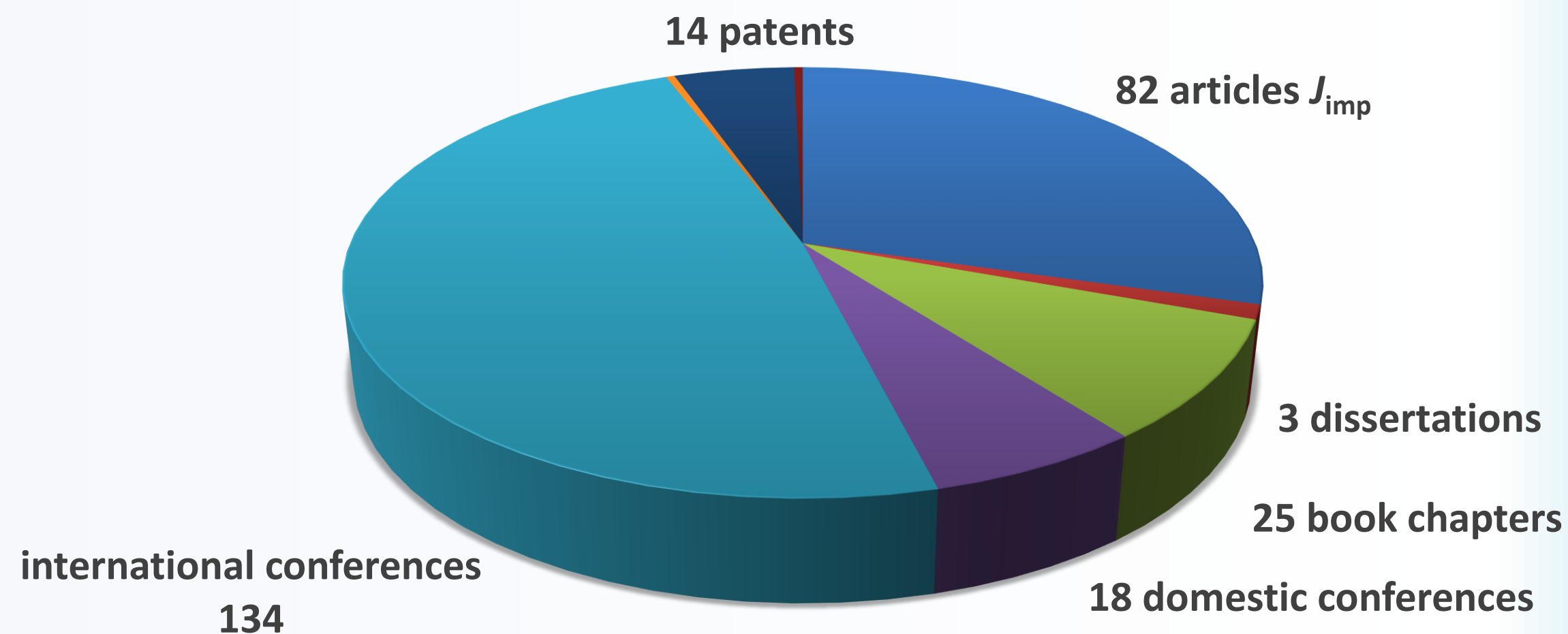
- Transfer of technologies

Implementor	Name of technology (license, patent)	Year	Revenues (1000s of EUR)
Futtec	Microwave asphalt melting for road repairing (license)	2016	44
Plastigram	Composite packaging materials recycling (license)	2016	111
MicroTech Industries	Microwave glass melting (patent)	2017	8
Regraplast	Method for polyurethane recycling (license)	2017	11
Pharmacan	Spin-off company bought license for separation of CBD from technical hemp (license + share of turnover)	2017	220
Fergia	Hydrolysis of biowaste (license)	2018	74
			468



ICPF basic facts

Publication productivity 2019



Trends in the quality structure of published papers

Year / Quartile	D1	Q1	Q2	Q3	Q4
2018	7	35	25	17	2
2019	3	34	30	8	7
2020	12	32	38	8	3



Our Mission

- Fundamental Research – several engineering disciplines, chemistry, and new materials
- **Emphasis on Applied and Industrial Research** – differentiates us from many of the institutes of CAS
- Fostering of young researchers, PhD students, and a new generation of scientists with complex knowledge, competencies, and skills and responsibility for their progress and tasks

Main Research Directions

Chemical sciences

Chemical sciences have a long tradition in our institute.

[More](#) →

Chemical engineering

We are a unique chemical engineering institute with a long history of research

[More](#) →

Environmental sciences

We are developing processes for environmental protection.

[More](#) →

New materials

We develop special materials for organic electronics and biomedical applications.

[More](#) →

Biotechnology

We focus on research in the field of new biotechnologies.

[More](#) →

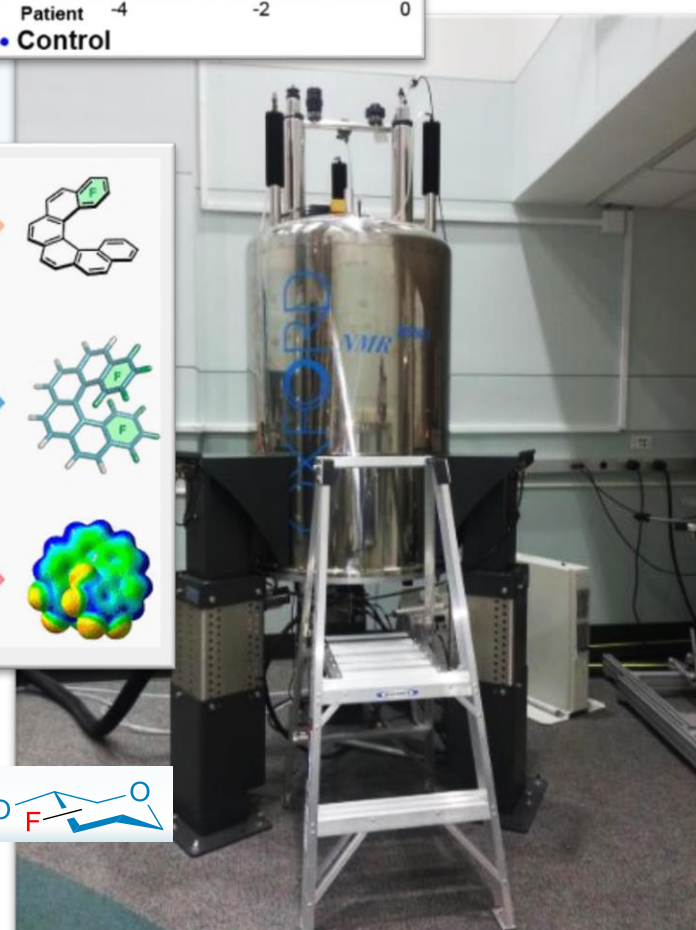
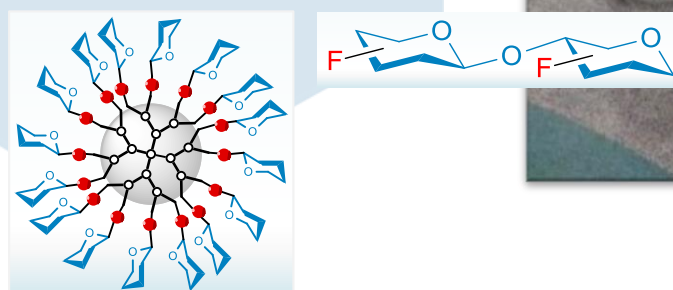
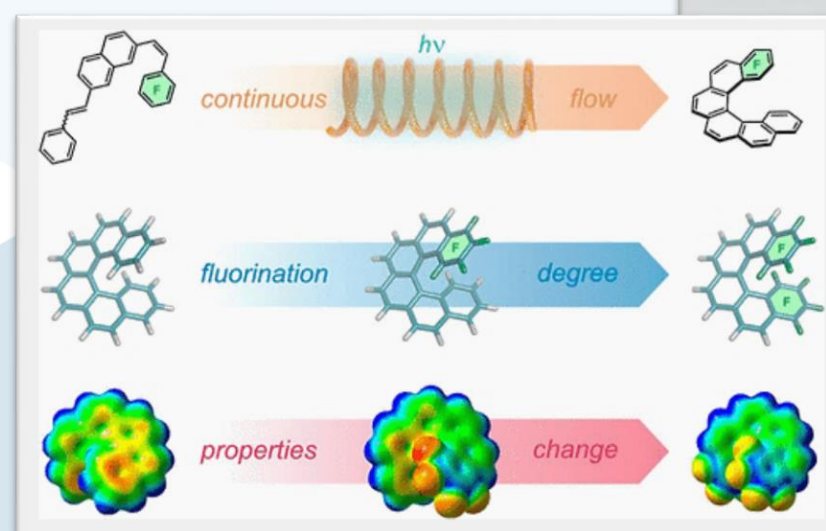
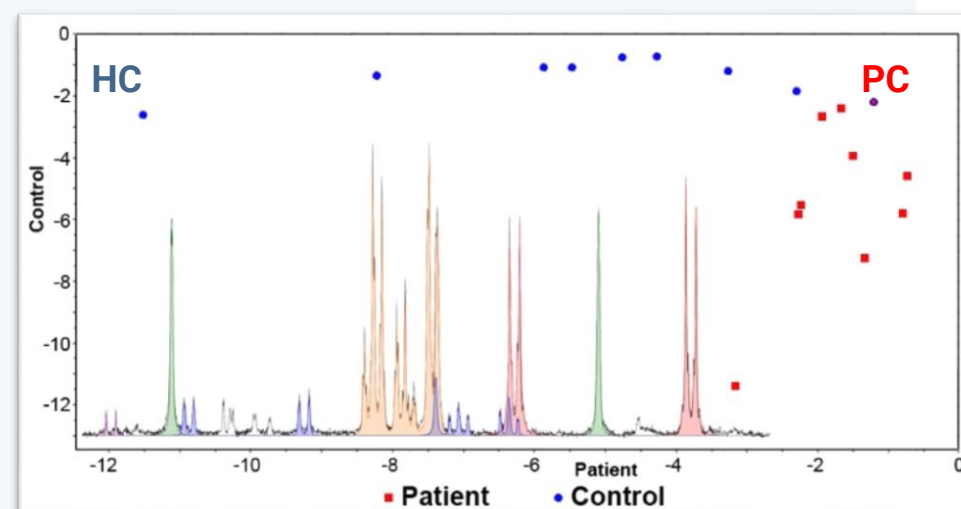
Chemical Sciences - I

Analytical Chemistry

- **Metabolomics**
- **Aerosolomics**
- **Analytical service** – NMR, HPLC, GC-MS, LC-NMR spectroscopy

Organic Chemistry

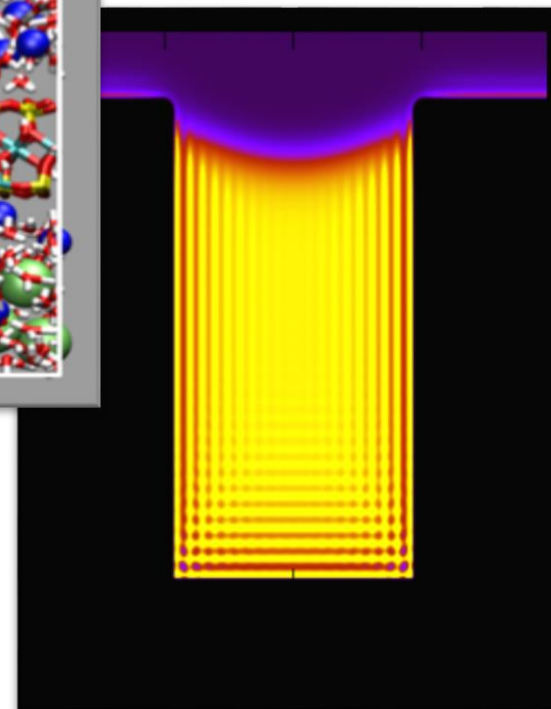
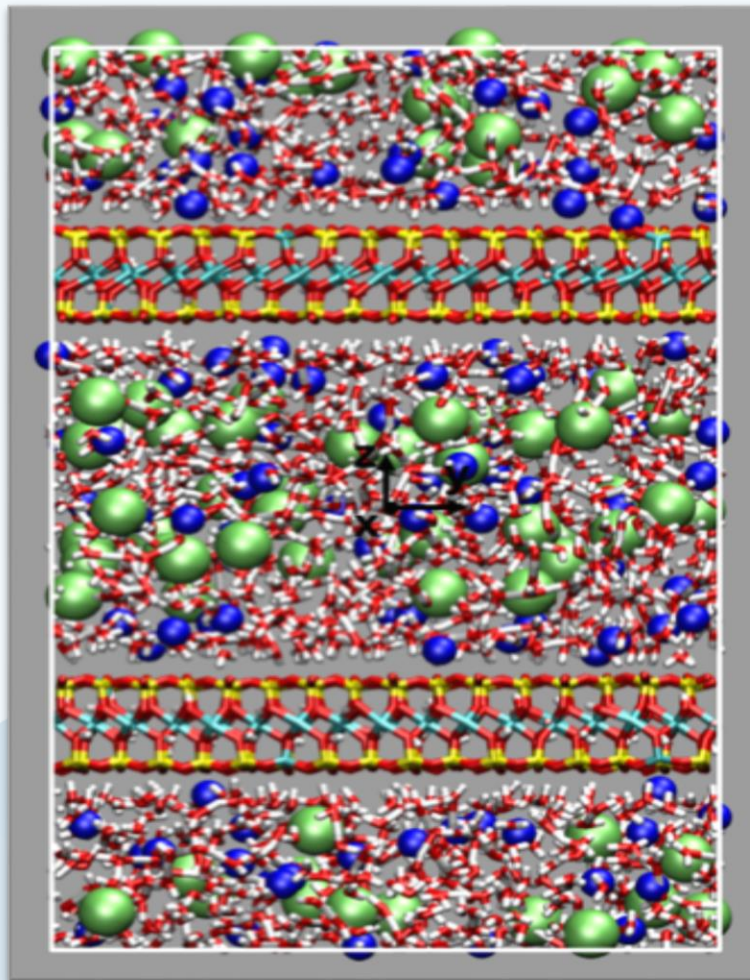
- **Photochemical synthesis** of helicenes and phenacenes (optical and electronic properties)
- **Preparation** of fluorinated carbohydrates, glycosides, and their multivalent analogues
- **Design** and preparation of new dendrimers, dendritic and hyperbranched molecules

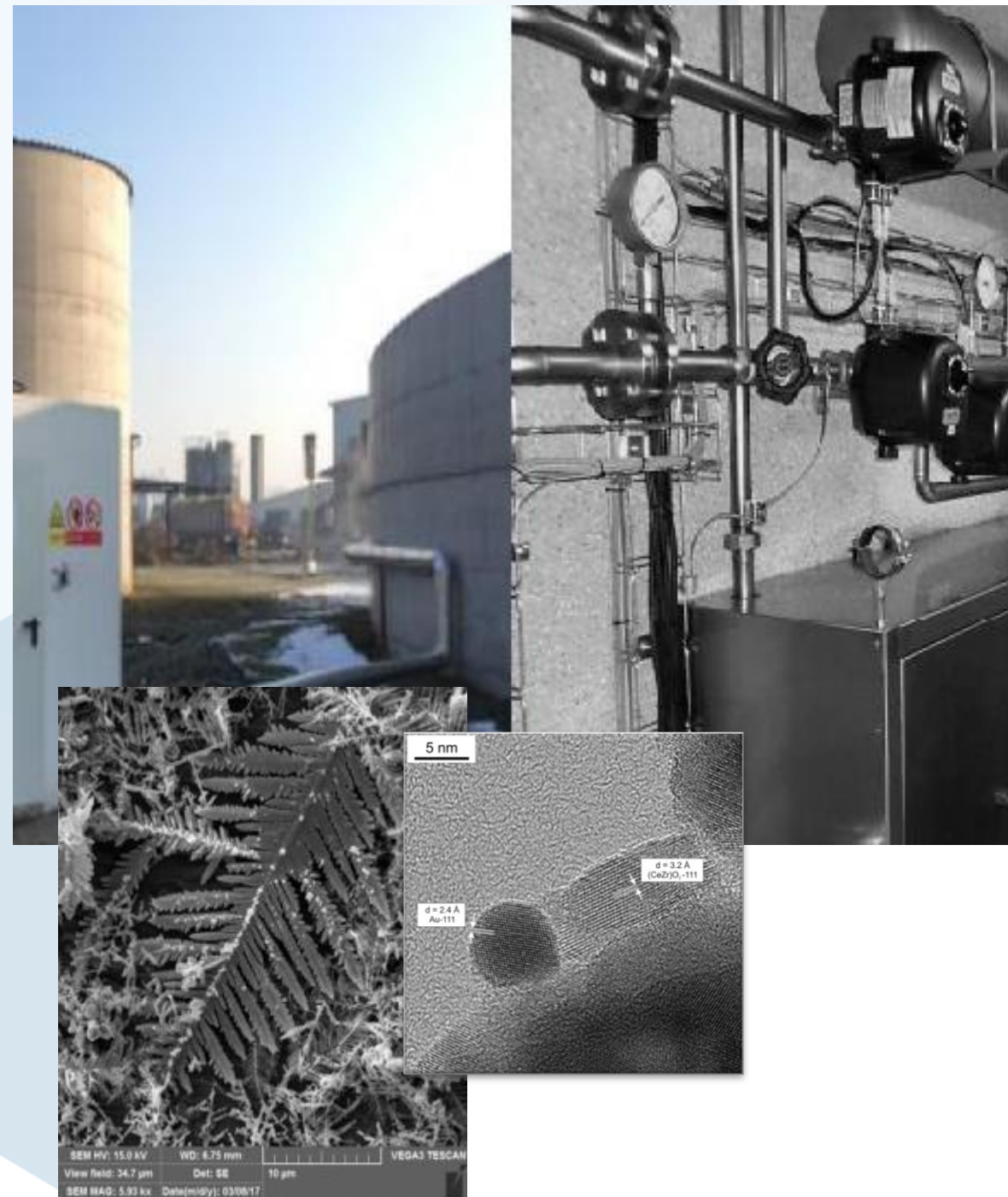


Chemical Sciences - II

Physical Chemistry

- **Computer modelling** at the molecular and mesoscopic level - complex fluid systems in the volume phase and in nanospace under equilibrium and non-equilibrium conditions
- **Properties of phase change** substances and heat transfer fluids (application in heat accumulators)





Chemical Engineering -I

Separation Processes

- **Membrane separation** is utilized for the separation of gas mixtures (cleaning raw biogas, separation of volatile organic compounds from the air, flue gas cleaning)

Catalysis and Reaction Engineering

- **Preparation of catalysts** and the study of mass transport in catalysts and their microstructure. Clarifying the relationships between the structure, composition, activity, and selectivity of oxidation catalysts
- **Textures and microstructures** of materials characterization

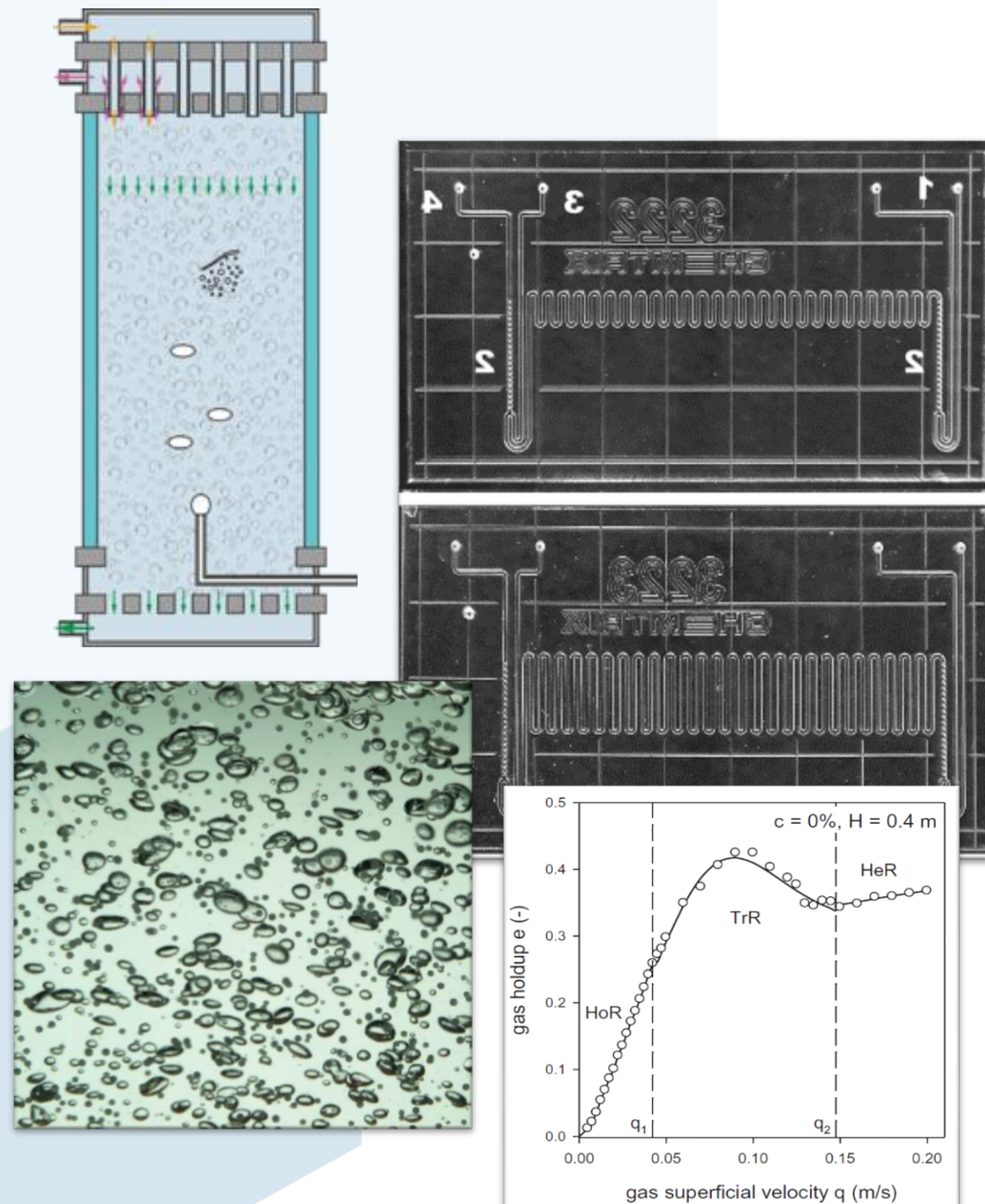
Chemical Engineering-II

Multiphase Systems

- Study in transport and reaction processes of **liquid-gas** systems
- Study of flow in **granular media** and liquid-gas-solid systems
- **Steady-state** and **dynamic processes** at the **phase interface**
- **Microreactors** development and applications

Supercritical Technology

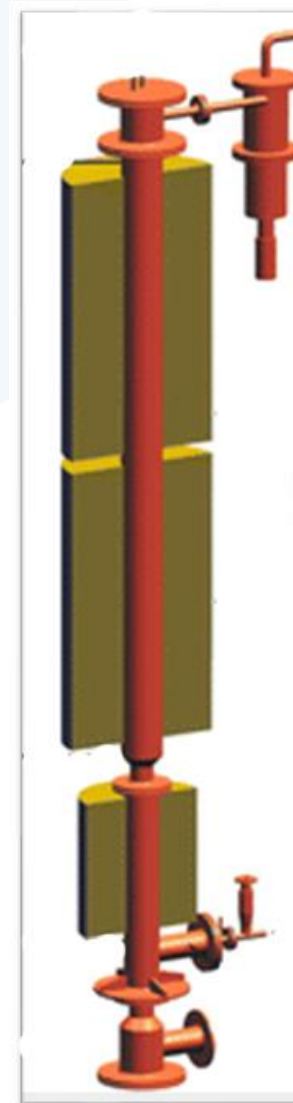
- **Separation methods** for obtaining **bioactive substances** from natural products
- New environment friendly methods for **preparing advanced materials**



Environmental Engineering - I

Environmental Engineering

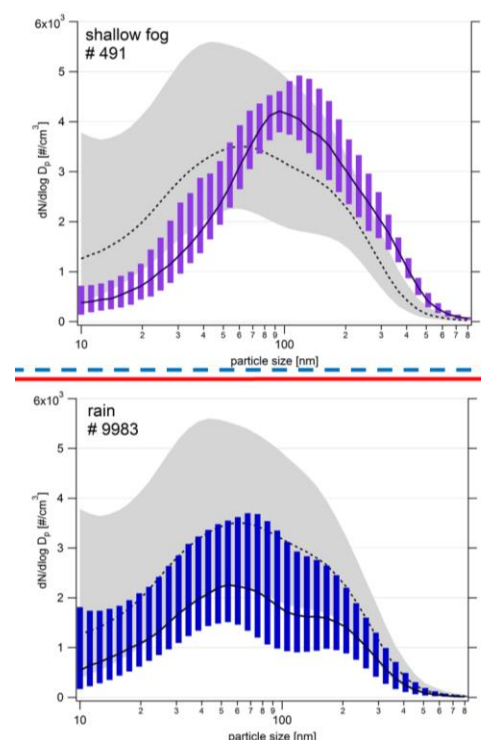
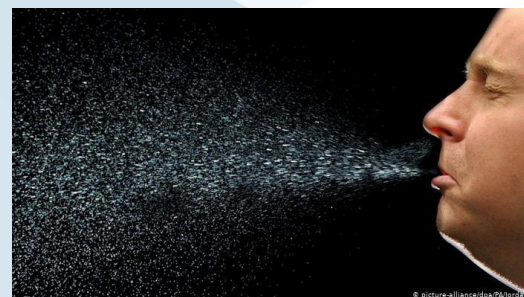
- **Energetics** - increasing the efficiency of thermochemical conversion of fuels, new and alternative fuels
- **Waste-to-Energy** - energy and material recovery of waste and the recycling of waste
- **Water** - removal of pollutants from wastewater and industrial wastewater (endocrine disruptors, organic compounds, heavy metals, and pharmaceuticals)

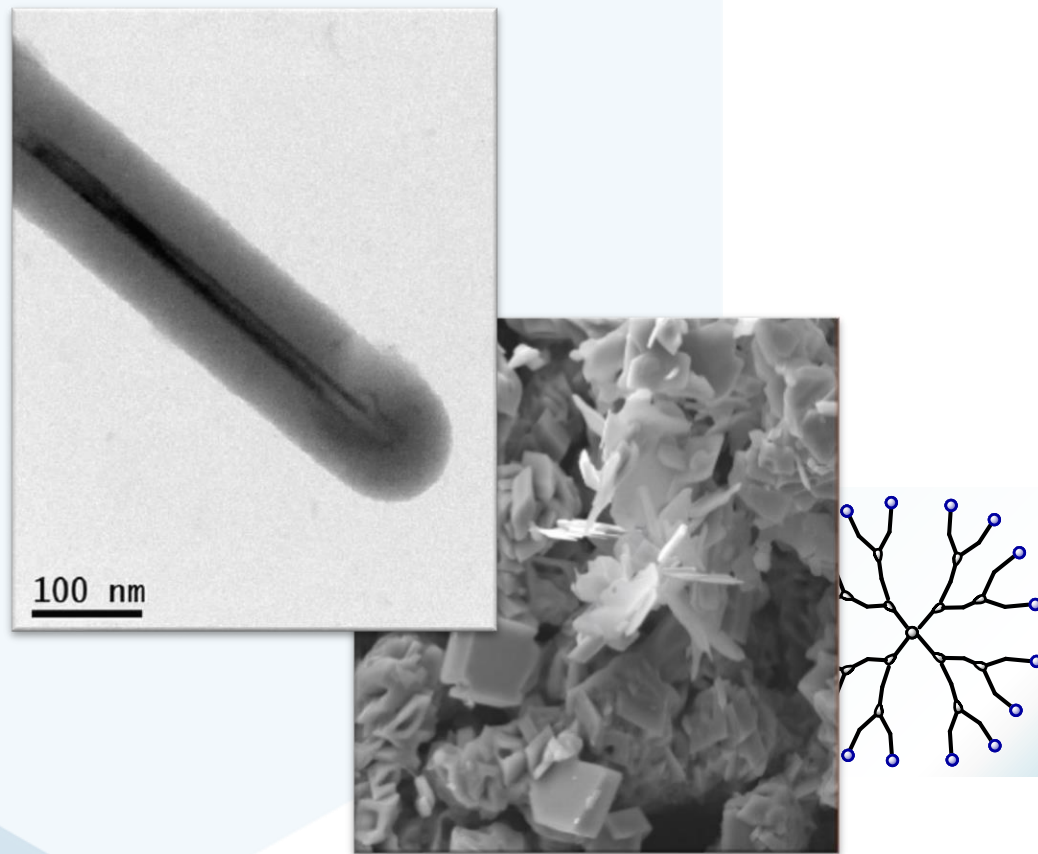


Environmental Engineering - II

Aerosols

- **Chemical and physical properties** of **atmospheric aerosols** and determining the share of various sources.
- **Behavior** of aerosols in **indoor environments**, kinetics of nucleation and growth, emission sampling of aerosol particles
- **Preparation of nanoparticles** for inhalation experiments





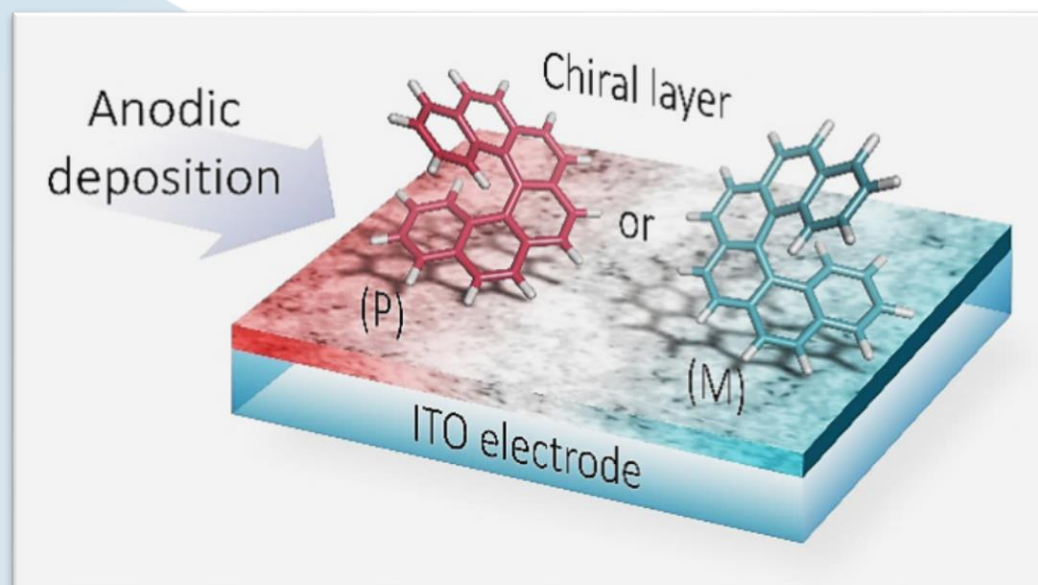
New Materials

Inorganic Materials

- **Laser Chemistry** – preparation of nanostructured materials based on silicon and germanium for photovoltaic applications and oxides, suboxides, oxycarbides, and oxynitrides for photocatalytic applications (laser ablation, radiofrequency deposition)

Organic Materials

- **Carbosilane structures** for use in biomedical applications
- **Phosphonium dendrimers** (complexes with therapeutic sequences of nucleic acids)
- **Ionic liquids** for energy storage

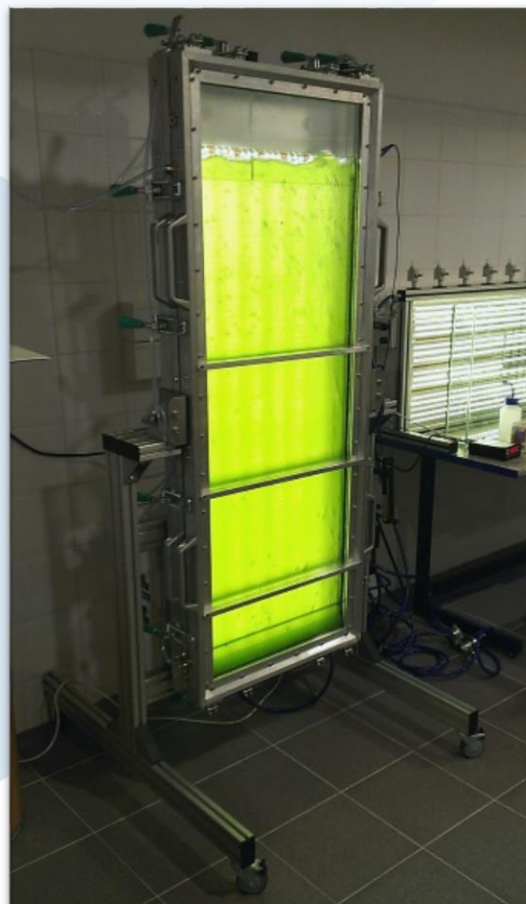




Biotechnologies- I

Biorefining Processes

- **Application of Chemical Engineering** in advanced biotechnology processes - creation of new products e.g. fertilizers from poultry cartilage or cosmetic and anti-inflammatory dermatological agents from plants
- **Medicinal applications** - adhesion of animal cells to various biopolymer meshes, membranes produced by an original method of electrospinning



Biotechnologies - II

Microbial Biotechnologies

- **Utilization** of microorganisms in environmental and food technologies (eukaryotic algae and cyanobacteria, bacteria and yeasts)
- **Development** of photobioreactors, optimization of separation processes and down-stream processes

Biocatalysis

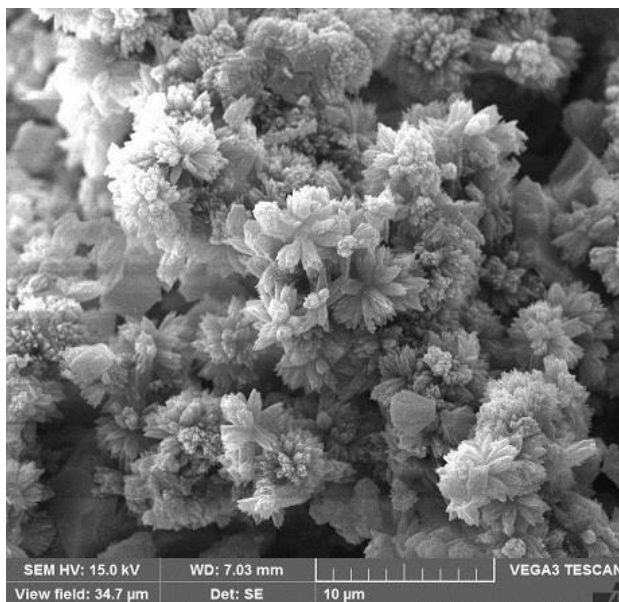
- **Biocatalysis** is carried out in supercritical carbon dioxide for the purpose of enriching vegetable oils with essential fatty acids through hydrolysis

Response ICPF to the COVID-19 pandemics



- **Department of Aerosols Chemistry and Physics** - testing Personal Protective Equipment (PPE) by the procedure developed in Institute, that enables us to determine the size-dependent filtration efficiency over a size range of 20-500 nm for 250 materials used in the production of respirators, face, medical, and homemade masks
- **Over 80 types of the whole masks** was tested on the so called Sheffield's head, normalized head of a mannequin used for this purpose
- **In order to avoid community spread of COVID-19, PPEs used for “source control”** might have higher impact **on slowing down the spread than protection of the wearer**

An evidence review of face masks against COVID-19. *Proceedings of the National Academy of Sciences of the U.S.A.* 118 (2021) e2014564118. ISSN 0027-8424. According to Preprints.org, it is the most viewed (370000 x) and most downloaded (89000 x) preprint ever.



- **In cooperation Department of Environmental Engineering** - developed antibacterial paper, which contains a special filler in the form of nanostructured complexes of zinc and silver
- **Destruction of all coronaviruses, bacteria, and yeast on the surface in half an hour**
- **with the paper company SPM - Security Paper Mill with the support of the Technology Agency of the Czech Republic**



Thank you for your attention

Institute of Chemical Process Fundamentals
of the Czech Academy of Sciences

