2021

Annual Report

Scientific Achievements

Faculty of Chemical and Process Engineering

WARSAW UNIVERSITY OF TECHNOLOGY

Authorities of the Faculty

Dean
Marek Henczka, PhD DSc Eng, full professor

Vice Dean for Scientific Affairs
Tomasz Sosnowski, PhD Dsc Eng, full professor

Vice Dean for Education
Łukasz Makowski, PhD DSc Eng, professor WUT

Vice Dean for Student Affairs
Maciej Pilarek, PhD DSc Eng, professor WUT

Vice Dean for Development
Wojciech Orciuch, PhD Eng

Structure of the Faculty, research and teaching staff

Chair of Integrated Processes Engineering

Head

Tomasz Sosnowski, PhD Dsc Eng, full professor

Scientists

Karol Ćwieka, PhD Eng
Agata Dorosz, MSc Eng
Jakub Gac, PhD DSc Eng, professor WUT
Leon Gradoń, PhD DSc Eng, full professor
Grzybowski Piotr, PhD Eng
Katarzyna Jabłczyńska, MSc Eng
Anna Jackiewicz-Zagórska, PhD Eng
Andrzej Krasiński, PhD DSc Eng, professor WUT
Arkadiusz Moskal, PhD DSc Eng, full professor
Marcin Odziomek, PhD Eng
Agata Penconek, PhD Eng
Rafał Przekop, PhD DSc Eng
Maciej Szwast, PhD DSc Eng, professor WUT
Łukasz Werner, PhD Eng
Bogumiła Wrzesińska, PhD Eng

Division of Biotechnology and Bioprocess Engineering

Head

Tomasz Ciach, PhD DSc Eng, full professor

Scientists

Beata Butruk-Raszeja, PhD Eng
Katarzyna Dąbkowska-Susfał, PhD Eng
Małgorzata Jaworska, PhD DSc Eng, professor WUT
Kamil Kopeć, MSc Eng
Andrzej Kołtuniewicz, PhD DSc Eng, full professor
Maciej Pilarek, PhD DSc Eng, professor WUT
Paweł Sobieszuk, PhD DSc Eng, professor WUT
Jakub Trzciński, PhD Eng
Karol Ulatowski, MSc Eng
Michał Wojasiński, PhD Eng

Division of Kinetics and Process Thermodynamics

Head

Eugeniusz Molga, PhD DSc Eng, full professor

Scientists

Anna Adach-Maciejewska, PhD Eng
Robert Cherbański, PhD DSc Eng, professor WUT
Ewa Dłuska, PhD DSc Eng, professor WUT
Tomasz Kotkowski, MSc Eng
Michał Lewak, PhD Eng
Piotr Machniewski, PhD Eng
Agnieszka Markowska-Radomska, PhD Eng
Leszek Rudniak, PhD Eng

Division of Engineering and Dynamic of Chemical Reactors

Head

Marek Henczka, PhD DSc Eng, full professor

Scientists

Małgorzta Djas, PhD Eng
Magdalena Jasińska, PhD DSc Eng, professor WUT
Katarzyna Kramek-Romanowska, PhD Eng
Jan Krzysztoforski, PhD Eng
Janusz Oleniak, PhD Eng
Antoni Rożeń, PhD DSc Eng

Division of Separation Processes

Head

Łukasz Makowski, PhD DSc Eng, professor WUT

Scientists

Paweł Gierycz, PhD DSc Eng, full professor
Roman Krzywda, PhD Eng
Artur Małolepszy, PhD
Marta Mazurkiewicz-Pawlicka, PhD Eng
Wojciech Orciuch, PhD Eng
Artur Poświata, PhD Eng
Krzysztof Wojtas, PhD Eng
Mariusz Zalewski, PhD Eng

Scientific reports

Chair of Integrated Processes Engineering

Katedra Inżynierii Procesów Zintegrowanych

Main research areas

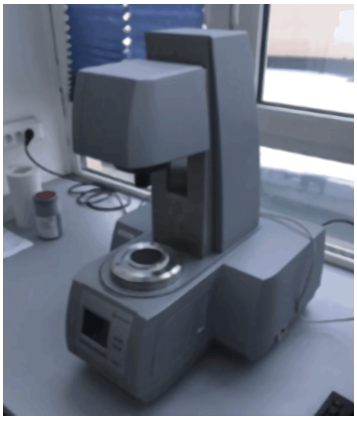
- Experimental and theoretical analysis of filtration processes in liquids and gases.
- Membranes and membrane processes: from laboratory-scale to industrial applications.
- Preparation and characterization of powders for drug delivery applications.
- Hydrodynamics and mass transfer in body fluids – computations and experiments.
- Engineering of inhaling devices.
- Organosilica aerogels – synthesis for specific applications, characterisation, modelling.
- Photocatalytic hydrogen generation – computational and experimental design of nano-photocatalysts, development of dedicated flow system.

Major scientific equipment and software

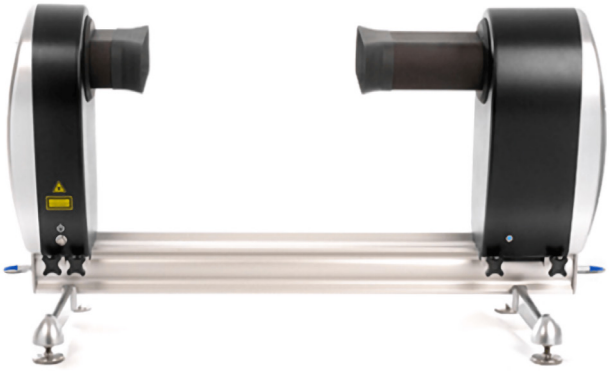
- Particle analysers in gases and liquids (Malvern Spraytec, FAPES, Grimm, cascade impactors)
- Filter-testing systems (Palas)
- Aerosol generators (TSI, Palas)
- Test rig for liquid-liquid coalescers (designed and assembled in-house)
- Test rig for antibacterial water filters (designed and delivered by Łukasiewicz ITeE, Radom)
- Semi-industrial scale, melt-blown system for non-woven material production
- Laboratory-scale system for solution-blow-spinning non-woven material production
- Rheometers and viscometers (Antor Paar, Fungilab, Brookfield)
- Surface tensiometers (Nima, Sinterface, Kruss) and goniometers (Dataphysics)
- Microscopes (SEM, optical, biological, fluorescence)
- Laboratory spray-dryer (Büchi)
- Analytical equipment (gas chromatograph, UV/VIS spectrometers, spectrofluorometer, HPLC)
- Breathing Simulator (Ingmar Medical)
- ANSYS Lumerical FDTD (ANSYS; software for Finite-Difference Time-Domain simulations)

Modular system for filter testing (Palas GmbH)

Spray-dryer (Büchi)



Rheometer MCR (Anton Paar)



Spraytec aerosol spectrometer (Malvern Instruments)

Cooperation with industrial partners

- Amazon Filters, Poland
- Atanox Technology sp. z o.o., Poland
- Atec GmbH, Germany
- Institute for Sustainable Technologies, Poland
- Norafin Industries GmbH, Germany
- PFTechnology sp. z o.o., Poland
- PolymemTech sp. z o.o., Poland
- Radpol SA, Poland
- Several companies of pharmaceutical and medical devices industry

Patent applications

- The use of organosilicon aerogels for the proliferation and immobilization of plant biomass in *in vitro* cultures and the use of aerogels to intensify the production of plant metabolites and intensify the in situ extraction of secondary metabolites in *in vitro* cultures (P.437075, 2021)

Mobilities

- Nina Borzęcka – University of Debrecen, Department of Chemistry (01.03.2021–31.03.2021)
- Katarzyna Jabłczyńska – ETH Zurich, Institute of Energy and Process Engineering (10.2021–09.2022)

Projects conducted in 2021

Project type	Title	PI
NCBR LIDER	High-performance flow system for photocatalytic production of hydrogen from biomass	Ćwieka Karol
NCBR TECHMATSTRATEG	Composite filter materials with extended operation time for water purification and for high-efficiency separation of gas-liquid and liquid-liquid systems	Krasiński Andrzej Ryszard
NCN PRELUDIUM	Study of the properties of substances of natural origin as potential functional components of inhalation drugs administered from nebulizers	Dobrowolska Katarzyna Ewa

Project type	Title	PI
NCN OPUS	Processes of liquid atomization for the targeted introduction of drugs into the respiratory system – mechanisms of drop formation, transport and deposition	Sosnowski Tomasz Robert
ERA-NET	Development of a new hybrid process of advanced wastewater treatment with the use of intelligent textile filters and graphene-modified polymer membranes	Szwast Maciej
NCN PRELUDIUM	Influence of inhalation inspiration dynamics on aerosolization, transport and deposition of therapeutic aerosols emitted from a passive powder inhaler	Dorosz Agata
ECOST-STSM	Investigation of hydrolysis and condensation reactions as the initial steps of the mechanism of MTMS-based aerogel synthesis	Borzęcka Nina

Projects granted in 2021 (start in 2022)

Project type	Title	PI
NCN PRELUDIUM	Organosilica aerogel shape-stabilized phase-change materials for solar distillation system enhancement	Nowak Bartosz

Excellence Initiative Research University (IDUB-POB) projects conducted in 2021

Project type	Title	PI
BIOTECHMED-1	Liquid dispersions of oxygen nanobubbles as carriers for aerosol drugs delivered from nebulizers	Odziomek Marcin
TechMat-1	Composite non-woven structures – photocatalytic nanoparticles for effective filtration of microbiologically contaminated air	Jabłczyńska Katarzyna
TechMat-1	Composite filter materials of polypropylene-ZnO designed for effective removal of abiotic and biotic particles from the air to improve the quality of life as well as human and environmental safety	Jackiewicz-Zagórska Anna
AGAINST COVID-19	The actual effectiveness of face shields and filter masks in reducing COVID-19 transmission – in vitro studies	Sosnowski Tomasz
TechMat-2	Synthesis and characterization of nanocatalysts based on two-dimensional rhenium disulfide (ReS_2) for photocatalytic hydrogen production	Werner Łukasz
TechMat-2	Formulation of highly elastic aerogels based on organoalkoxysilanes	Gac Jakub

Czelej K., Colmenares J.C., **Jabłczyńska K., Ćwieka K.**, **Werner Ł.**, **Gradoń L.** (2021) Sustainable hydrogen production by plasmonic thermophotocatalysis. *Catal. Today* 380, 156–186, DOI:10.1016/j.cattod.2021.02.004

Kramek-Romanowska K., Stecka A.M., Zieliński K., **Dorosz A.**, Okrzeja P., Michnikowski M., **Odziomek M.** (2021) Independent lung ventilation-experimental studies on a 3D printed respiratory tract model. *Materials* 14(18), 1–15, DOI:10.3390/ma14185189

Niewolik D., Bednarczyk-Cwynar B., Ruszkowski P., **Sosnowski T.R.**, Jaszcz K. (2021) Bioactive betulin and PEG based polyanhydrides for use in drug delivery systems. *Int. J. Mol. Sci.* 22, nr 3, 2021, s. 1–20, DOI:10.3390/ijms22031090

Bielecki Z., Ochowiak M., Włodarczak S., Krupińska A., Matuszak M., Lewtak R., Dziuba J., Szajna E., Choiński D., **Odziomek M.** (2021) The analysis of the possibility of feeding a liquid catalyst to a coal dust channel. *Energies* 14, nr 24, 8521, DOI:10.3390/en14248521

Filice S., Bongiorno C., Libertino S., Compagnini G., **Gradoń L.**, Iannazzo D., La Magna A., Scalese S. (2021) Structural characterization and adsorption properties of Dunino raw halloysite mineral for dye removal from water. *Materials* 14, nr 13, 1–21, DOI:10.3390/ma14133676

Sosnowski T.R. (2021) Inhaled aerosols: their role in COVID-19 transmission including biophysical interactions in the lungs. *Curr. Opin. Colloid Interface Sci.* 54, 1–12, DOI:10.1016/j.cocis.2021.101451

Milewski J., **Ćwieka K.**, Szczęśniak A., Szabłowski Ł., Wejrzanowski T., Skibiński J., Dybiński O., Lysik A., Sienko A., Stanger P. (2021) Recycling electronic scrap to make molten carbonate fuel cell cathodes. *Int. J. Hydrog. Energy* in press

Bogdanowicz A., Żubrowska-Sudoł M., **Krasiński A.R.**, Sudoł M. (2021) Cross-contamination as a problem in collection and analysis of environmental samples containing microplastics – A review. *Sustainability* 13, nr 21, 1–18, DOI:10.3390/su132112123

Nowak B., Kawka M., Wierzchowski K., Sykłowska-Baranek K., Pilarek M. (2021) MTMS-based aerogel constructs for immobilization of plant hairy roots: Effects on proliferation of Rindera graeca biomass and extracellular secretion of naphthoquinones. *J. Funct. Biomater.* 12, nr 1, 1–15, DOI:10.3390/jfb12010019

Wiśniak-Sawka M., Maziejuk M., Fabianowski W., Karpińska U., **Szwast M.**, Weremczuk J. (2021) Capillary sensor for detection of amphetamine precursors in sewage water. *Polymers* 13, nr 11, 1–9, DOI:10.3390/polym13111846

Polak D., **Zielińska I.**, **Szwast M.**, Kogut I., Małolepszy A. (2021) Modification of ceramic membranes with carbon compounds for pharmaceutical substances removal from water in a filtration–adsorption system. *Membranes* 11, nr 7, 1–12, DOI:10.3390/membranes11070481

Polak D., Tonecka I., Fabianowski W., **Szwast M.** (2021) Development of graphene oxide-coated membranes to support the process of removing pharmacological agents from water. *Desalination Water Treat.* 214, 49–55, DOI:10.5004/dwt.2021.26645

Dorosz A., Urbankowski T., Zieliński K., Michnikowski M., Krenke R., **Moskal A.** (2021) Inhalation profiles through a dry powder inhaler: relation between inhalation technique and spirometric measures. *J Aerosol Med Pulm Drug Deliv* 34, nr 6 DOI:10.1089/jamp.2020.1663

Krasiński A.R., Sołtan Ł., Kozyrski J. (2021) The effect of solids on interfacial rheology and the performance of coalescence filters. *CHEM PROCESS ENG-INZ* 42, nr 4, 337–348, DOI:10.24425/cpe.2021.138934

Polak D., Sułkowska J., **Szwast M.** (2021) The influence of surfactant Pluronic P123 addition on the mixed matrix membrane PEBAX 2533 – ZIF-8 separation properties. *Desalination Water Treat.* 214, 64–73, DOI:10.5004/dwt.2021.26647

Sosnowski T.R., Janeczek K., Grzywna K., Emeryk A. (2021) Mass and volume balances of nebulization processes for the determination of the expected dose of liquid medicines delivered by inhalation. *CHEM PROCESS ENG-INZ* 42, nr 3, 253–261, DOI:10.24425/cpe.2021.138929

Kogut I., **Szwast M.**, Hussy S., **Polak D.**, Gerhardts A., Piątkiewicz W. (2021) Evaluation of wastewater reuse in commercial laundries: a pilot field study. *Desalination Water Treat.* 214, 39–48, DOI:10.5004/dwt.2021.26531

Ćwieka K., Czelej K., Colmenares J.C., **Jabłczyńska K.**, **Werner Ł.**, **Gradoń L.** (2021) Supported plasmonic nanocatalysts for hydrogen production by wet and dry photoreforming of biomass and biogas derived

compounds: Recent progress and future perspectives. *ChemCatChem.* 13, nr 21, 4458–4496, DOI:10.1002/cctc.202101006

Zielińska I., **Polak D.**, **Szwast M.** (2021) Analysis of the adsorption of selected pharmaceuticals on a composite material PEBAX/GO. *J. Water Process. Eng.* 44, 1–7, DOI:10.1016/j.jwpe.2021.102272

Krzywda R., **Wrzesińska B.** (2021) Simulation of the condensation and fractionation unit in waste plastics pyrolysis plant. *Waste Biomass Valori.* 12, nr 1, 91–104, DOI:10.1007/s12649-020-00994-7

Dorosz A., Żaczek M., **Moskal A.** (2021) Dynamics of aerosol generation and release – Dry powder inhaler performance considerations. *J Aerosol Sci* 151, 1–13, DOI:10.1016/j.jaerosci.2020.105673

Krasiński A.R., **Jachimczyk P.** (2021) Surface modification of a polyester-augmented cellulose filter for dehydration of low-sulfur diesel. *ACS Omega* 6, nr 28, 18065–18073, DOI:10.1021/acsomega.1c01871

Emeryk A., **Sosnowski T.R.**, Kupczyk M., Śliwiński P., Zajdel-Całkowska J., Zielonka T.M., Mastalerz-Migas A. (2021) Impact of inhalers used in the treatment of respiratory diseases on global warming. *Adv Respir Med* 89, nr 4, 427–438, DOI:10.5603/arm.a2021.0092

Sosnowski T.R., **Dobrowolska K.E.** (2021) Aerodynamically driven translocation of non-Newtonian fluids: the relevance for intranasal drug delivery. *Chem. Eng. Trans.* 86, 1207–1212, DOI:10.3303/CET2186202

Emeryk A., Janeczek K., **Sosnowski T.R.**, Emeryk-Maksymiuk J. (2021) Połączenia glikokortykosteroidu z długo działającym β2-mimetykiem w inhalatorze ciśnieniowym dozującym – jakie, komu, kiedy?. *Alergoprofil Med.Educ.* 17, nr 3, 19–26, DOI:10.24292/01.ap.173300821

Borzęcka N., **Nowak B.**, Pakuła R., Przewodzki R., **Gac J.M.** (2021) Cellular automata modeling of silica aerogel condensation kinetics. *Gels* 7, nr 2, 1–12, DOI:10.3390/gels7020050

Sosnowski T.R., Emeryk A., Janeczek K., Emeryk-Maksymiuk J. (2021) Czy preparaty propionianu flutykazonu z salmeterolem z pMDI są takie same? Doniesienie wstępne. *Alergoprofil Med.Educ.* 17, nr 3, 39–44, DOI:10.24292/01.ap.173302821

Sosnowski T.R., **Dobrowolska K.E.** (2021) Wybrane zagadnienia fizykochemii koloidów w procesach inhalacyjnego dostarczania leków do płuc. *Wiad. Chem.* 75, nr 9–10, 1375–1393

Book chapters

Emeryk A., Pirożyński M., Mazurek H.: (red.) Emeryk A., Pirożyński M., Mazurek H., Janeczek K., **Sosnowski T.R.**, Florkiewicz E. (2021) Polski przewodnik inhalacyjny. *VM Media sp. z o.o. VM Group sp.k.* (*grupa Via Medica*), ISBN 978-83-66645-46-2

Voitau I., **Sosnowski T.R.**: (red.) Wilkocki A., Saevitch N., Voitau I., **Sosnowski T.R.**, Borowik A. (2021) Процессы и аппараты химической технологии. Техническая гидравлика. *Белорусский государственный технологический университет* (*Białoruski Państwowy Instytut Technologiczny*), ISBN 978-985-530-881-3

Atamanyuk V., Badyda A.J., Dzinyak B., Grzyb S., Igras J., Kresinski R., Nebesnyi R., Sadowska M., Skorokhoda V., **Sosnowski T.R.** (red.) (2021) *Chemical Technology and Engineering: Monograph. SPOLOM,* ISBN 978-966-919-760-3

Publications in conference proceedings

Dobrowolska K.E., Matyśkiewicz M., **Sosnowski T.R.** (2021) Effect of liquid properties and aerosol dilution conditions on the final droplet size of aerosol delivered from nebulizers. *EYEC Monograph: 9th European Young Engineers Conference,* 152–152 ISBN 978-83-936575-9-9

Odziomek M., **Dobrowolska K.E.**, Ulatowski K., Sobieszuk P., **Sosnowski T.R.** (2021) Atomization of oxygen nanodispersions in isotonic saline for applications in aerosol therapy. *3rd International Scientific Conference "Chemical Technology and Engineering", Chemical technology and engineering. Proceedings* 161–163, DOI:10.23939/cte2021.01.161

Sosnowski T.R., **Dobrowolska K.E.** (2021) Liquid atomization process in medical applications. *3rd International Scientific Conference "Chemical Technology and Engineering", Chemical technology and engineering. Proceedings* 159–160

DOI:10.23939/cte2021.01.161

Sosnowski T.R., **Odziomek M.** (2021) Particle size dynamics: Toward a better understanding of electronic cigarette aerosol interactions with the respiratory system. Characteristics and composition of aerosol generated by electronic cigarettes: What is the impact on human health? *Frontiers Media SA* 74–81, ISBN 978-288-971-388-2

Sosnowski T.R., **Odziomek M.**, **Dorosz A.** (2021) Usefulness of facial masks against COVID-19 transmission – an experimental evidence. 3rd *International Scientific Conference "Chemical Technology and Engineering", Chemical technology and engineering. Proceedings* 203–207, DOI:10.23939/cte2021.01.161

Sosnowski T.R., **Odziomek M.**, **Dorosz A.** (2021) Usefulness of facial masks against COVID-19 transmission – an experimental evidence. *Chemical Technology and Engineering: Monograph, SPOLOM* 122–126, ISBN 978-966-919-760-3

Awards

- Izabela Zielińska – 3rd Place in Best Poster Competition on "Membranes and Membrane Processes in Environmental Protection" Conference
- Andrzej Krasiński – 2nd degree individual award for Organizational Achievements
- Karol Ćwieka – "Scientist of the Future" founded by the Intelligent Development Center on June 14, 2021 in category "Technical science for innovative future" for leading the research project LIDER "High performance flow system for photocatalytic hydrogen production from biomass".

Division of Biotechnology and Bioprocess Engineering

Zakład Biotechnologii i Inżynierii Bioprocesowej

Main research areas

- Preparation, characterization and biomedical application of polymer materials, organic and inorganic nanoparticles, nano- and submicrometric fibers, hydroxyapatite nanoparticles, graphene and graphene oxide
- Surface modifications of biomaterials (bioactive/biopassive coatings, enhancing biocompatibility and hemocompatibility)
- Tissue engineered vascular grafts
- Enzyme and peptides immobilization
- Chitin and chitosan modification: enzymatic and with ionic liquids
- Fungal chitin and chitosan production
- Microfluidic systems for pathogen detection
- Studies of surface plasmon resonance phenomenon applications
- Scaling-up of animal cell cultures in single-use bioreactor systems
- Multifunctional platforms for *in vitro* bioprocessing of transgenic roots
- Liquid perfluorochemicals as *in situ* carriers of metabolites in animal and plant cell cultures
- Formation, properties and application of gas nanobubbles
- Processing of lignocellulosic biomass into biofuels and other valuable chemicals
- 3D printing of composite materials for biomedical applications

Major scientific equipment and software:

Confocal Laser Scanning Microscope: Carl Zeiss LSM 880

ReadyToProcess WAVE 25 bioreactor

- Bioreactors (volume from 1 L to 5 L, Biostat B bioreactor system)
- Single-use bioreactor system supporting wave-type agitation (ReadyToProcess WAVE 25 bioreactor system)
- Microscopes (SEM, optical, fluorescence, confocal)
- Sterile clean-room laboratories for cell culture and for working with blood (laminar chambers, autoclaves, incubators, spectroscopic plates readers, etc.)
- Equipment for chemical analysis (HPLC with UV and RI detectors, GC, spectrofluorimeter, UV/VIS spectrometers, FTIR-ATR spectrometer)
- Nanoparticles analyzing equipment: DLS (Zetasizer NanoZS) and NTA (NanoSight LM10)
- Goniometer – Drop Shape Analysis System DSA100, Krüss
- Rheometer LVDV-III+, Brookfield, viscosity range 0.4 – 92,130 mPa·s
- Surface plasmon resonance analyzer – SensiQ Explorer
- Automated hematology analyzer Sysmex CA 620
- Z-Morph 3D fabricator (printing, laser cutting, CNC milling, etc.)
- Formlabs Form 3+, 3D resin printer
- High vacuum manifold line (10^{-3} mbar)
- Self-made tribometer for friction coefficients measurements
- Mechanical testing machine Instron 3345 with maximum load of 50 N or 5 kN (tensile, compression, and 3-point bend testing capabilities)

Cooperation with industrial partners

- Balton Sp. z o.o., Poland
- Polfa SA, Poland

Patent applications

- Method of continuous processing of lignocellulose to fuels and chemicals in membrane reactors (A1 433697, 2020)
- The use of organosilicon aerogels for the proliferation and immobilization of plant biomass in *in vitro* cultures and the use of aerogels to intensify the production of plant metabolites and intensify the in situ extraction of secondary metabolites in in vitro cultures (P.437075, 2021)
- The use of biodegradable polymers to intensify the proliferation and immobilization of plant biomass as well as to intensify the production and in situ extraction of plant metabolites in *in vitro* cultures (P.439617, 2021)

Mobility

- Michał Wojasiński – University of Michigan, College of Engineering, Department of Biomedical Engineering (10.2021 – 09.2022)

Projects conducted in 2021

Project type	Title	PI
NCBR LIDER	Epidermal hydrogel nanoformulation of alendronic acid for transdermal release	Trzciński Jakub Waldemar
NCN PRELUDIUM	Assessment of the effect of adenosine contained in 3D printed polymer-ceramic implants coated with a hydrogel on the behavior and growth of bone and cartilage cells	Podgórski Rafał Kamil
ERA-NET	A drug-releasing ultra-low friction coating for the urological guide wire designed to reduce trauma during surgical removal of kidney stones	Ciach Tomasz
NCN OPUS	Obtaining and testing the properties of gas nanobubbles in liquids	Sobieszuk Paweł
NCBR Polska-RPA	Advanced coatings for urological medical devices	Ciach Tomasz
NCBR Polsko-Tajwański	Scaffolds for guided regeneration of nervous and muscle tissue	Ciach Tomasz
NCN PRELUDIUM	Study of the process of attaching saccharides to cellular glucose receptors, taking into account the phenomena related to mass transport	Trzaskowski Maciej
NCBR LIDER	BioGraft – biomimetic vascular prostheses of small diameters	Butruk-Raszeja Beata Aleksandra
NCBR POIR	A new regeneration method of intervertebral disc	Ciach Tomasz

Projects granted in 2021 (start in 2022)

Project type	Title	PI
NCN PRELUDIUM	Polymer platforms/scaffolds for the intensified production of biomass of plant organs and metabolites in a single-use bioreactor	Wierzchowski Kamil
NCN OPUS-LAP	Vascular endothelium-supporting materials: Understanding the structural and physicochemical requirements	Ciach Tomasz
BEYOND-POB-2	Integrated biotechnological production of bioethanol and xylitol from agricultural lignocellulosic waste after alkaline pretreatment	Dąbkowska-Susfał Katarzyna

Excellence Initiative Research University (IDUB-POB) projects conducted in 2021

Project type	Title	PI
BIOTECHMED-1	Development of nanohydroxyapatite/alendronate/lecithin formulations with increased cellular uptake in vitro	Wojasiński Michał
AGAINST COVID-19	Development of a nano-vaccine based on recombinant SARS-CoV2 virus proteins covalently bound to nanoparticles	Ciach Tomasz
BIOTECHMED-2	Bifunctional aerogel-based platforms for intensification of naphthoquinones biosynthesis in transgenic roots cultured in vitro	Pilarek Maciej
BIOTECHMED-2	3D printing of polycaprolactone/modified nanohydroxyapatite composites with mechanical and osteoinductive properties required for bone implants	Sobieszuk Paweł

JCR Publications

All DOIs in the following sections contain links leading directly to the listed publications.

Auguścik-Królikowska M., Ryszkowska J., Kurańska M., Wantulok M., Gloc M., Szczepkowski L., **Dąbkowska-Susfał K.**, Prociak A. (2021) Composites of Open-Cell Viscoelastic Foams with Blackcurrant Pomace. *Materials* 14, nr 4, 1–22, DOI:10.3390/ma14040934

Kobuszewska A., Kołodziejek D., **Wojasiński M.**, Jastrzębska E., **Ciach T.**, Brzózka A. (2021) Lab-on-a-chip system integrated with nanofiber mats used as a potential tool to study cardiovascular diseases (CVDs). *Sens. Actuators B Chem.* 330, 1–12, DOI:10.1016/j.snb.2020.129291

Wojasiński M., **Latocha J.**, Liszewska P., Makowski Ł., **Sobieszuk P.**, **Ciach T.** (2021) Scaled-up 3D-printed reactor for precipitation of lecithin-modified hydroxyapatite nanoparticles. *Ind. Eng. Chem. Res.* 60, nr 35, 12944–12955, DOI:10.1021/acs.iecr.1c02973

Kuźmińska A., Kwarta D., **Ciach T.**, **Butruk-Raszeja B.** (2021) Cylindrical polyurethane scaffold fabricated using the phase inversion method: Influence of process parameters on scaffolds' morphology and mechanical properties. *Materials* 14, nr 11, 2021, 1–21, DOI:10.3390/ma14112977

Sobieszuk P., Strzyżewska A., **Ulatowski K.** (2021) Investigation of the possibility of culturing aerobic yeast with oxygen nanobubble addition and evaluation of the results of batch and semi-batch cultures of Saccharomyces cerevisiae.

Chem. Eng. Process.: Process Intensif. 159, 1–9, DOI:10.1016/j.cep.2020.108247

Wierzchowski K., **Kuźmińska A.**, **Pilarek M.** (2021) Intensification of chondrocytes proliferation by microcarriers and wave-induced mixing: Reynolds number influence on CP5 cells growth. *Chem. Eng. Process.: Process Intensif.* 166, 1–9, DOI:10.1016/j.cep.2021.108472

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Czwartos J., Budner B., Bartnik A., Wachulak P., **Butruk-Raszeja B.**, Lech A., **Ciach T.**, Fiedorowicz H. (2021) Effect of extreme ultraviolet (EUV) radiation and EUV induced, N_2 and O_2 based plasmas on a PEEK surface's physico-chemical properties and MG63 cell adhesion. *Int. J. Mol. Sci.* 22, nr 16, 1–22, DOI:10.3390/ijms22168455

Łopianiak I., **Wojasiński M.**, **Kuźmińska A.**, **Trzaskowska P.**, **Butruk-Raszeja B.** (2021) The effect of surface morphology on endothelial and smooth muscle cells growth on blow-spun fibrous scaffolds. *J. Biol. Eng.* 15, nr 1, 1–17, DOI:10.1186/s13036-021-00278-1

Wierzchowski K., **Sobieszuk P.**, **Pilarek M.** (2021) Oxygen transfer effects in a two-phase system of an aqueous phase and liquid perfluorochemical subjected to continuous wave-assisted agitation in disposable bioreactor. *Energies* 14, nr 14, 1–15, DOI:10.3390/en14144381

Kowalczyk P., **Podgórski R.**, **Wojasiński M.**, Gut G., Bojar W., **Ciach T.** (2021) Chitosan-human bone composite granulates for guided bone regeneration. *Int. J. Mol. Sci.* 22, nr 5, 1–15, DOI:10.3390/ijms22052324

Kuźmińska A., Wojciechowska A., **Butruk-Raszeja B.** (2021) Vascular polyurethane prostheses modified with a bioactive coating – physicochemical, mechanical and biological properties. *Int. J. Mol. Sci.* 22, nr 22, 1–20, DOI:10.3390/ijms222212183

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Nowak B., Kawka M., **Wierzchowski K.**, Sykłowska-Baranek K., **Pilarek M.** (2021) MTMS-based aerogel constructs for immobilization of plant hairy roots: Effects on proliferation of Rindera graeca biomass and extracellular secretion of naphthoquinones. *J. Funct. Biomater.* 12, nr 1, 1–15, DOI:10.3390/jfb12010019

Major R., Kopernik M., **Kuźmińska A.**, Imbir G., Plutecka H., Pomorska M., **Ciach T.**, Lackner J.M. (2021) In vitro haemocompatibility assessment of acrylic acid deposited on solid, polyurethane substrate. *Colloids Surf. B* 199, 1–9, DOI:10.1016/j.colsurfb.2021.111562

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Gadomska-Gajadhur A., Kruk A., **Wierzchowski K.**, Ruśkowski P., **Pilarek P.** (2021) Design of experiments-based strategy for development and optimization of polylactide membranes preparation by wet inversion phase method. *Polym Adv Technol* 32, nr 8, 3028–3038, DOI:10.1002/pat.5315

Kobuszewska A., Kołodziejek D., **Wojasiński M.**, **Ciach T.**, Brzózka Z., Jastrzębska E.

(2021) Study of stem cells influence on cardiac cells cultured with a cyanide-p-trifluoromethoxyphenylhydrazone in Organ-on-a-Chip system. *Biosensors* 11, nr 5, 1–14, DOI:10.3390/bios11050131

Sikorski J., Obarski N., **Trzaskowski M.**, Matczuk M. (2021) Simple Ultraviolet–Visible Spectroscopy-Based Assay for Fast Evaluation of Magnetic Nanoparticle Selectivity Changes After Doping. *Appl. Spectrosc.* 75, 1305–1311, DOI:10.1177/00037028211028669

Kopeć K., Żuk M., **Ciach T.** (2021) Hydrogel antibacterial coating for silicone medical devices. *Prog Chem Appl Chitin Deriv* 26, 135–147, DOI:10.15259/pcacd.26.012

Janczewska M., Szkop M., Pikus G., Kopyra K., Świątkowska A., Brygoła K., Karczmarczyk U., Walczak J., Żuk M., **Ciach T.** (2021) PSMA targeted conjugates based on dextran. *Appl Radiat Isot* 167, 1–9, DOI:10.1016/j.apradiso.2020.109439

Publications in conference proceedings

Bartczak M., **Wierzchowski K.**, **Pilarek M.** (2021) Adaptation of the sensor method for the determination of mixing time in a rocking single-use bioreactor. *3rd International Scientific Conference "Chemical Technology and Engineering", Chemical technology and engineering. Proceedings* 166–168, DOI:10.23939/cte2021.01.166

Odziomek M., Dobrowolska K., **Ulatowski K.**, **Sobieszuk P.**, Sosnowski T.R. (2021) Atomization of oxygen nanodispersions in isotonic saline for applications in aerosol therapy. *3rd International Scientific Conference "Chemical Technology and Engineering", Chemical technology and engineering. Proceedings* 161–163, DOI:10.23939/cte2021.01.161

Rybak E., **Ciach T.** (2021) Preparation of polycaprolactone nanoparticles via nanoprecipitation method and evaluation of their properties; *EYEC Monograph: 9th European Young Engineers* 69–74, ISBN 978-83-936575-9-9

Wierzchowski K., Kawka M., Sykłowska-Baranek K., **Pilarek M.** (2021) Proliferation of Rindera graeca transgenic roots in oscillatory rocked disposable bioreactor; *3rd International Scientific Conference "Chemical Technology and Engineering"* 164–165, DOI:10.23939/cte2021.01.164

Wyrębiak P., **Poniatowska A.**, **Ciach T.** (2021) N-doped carbon nanoparticles: properties and influence on mouse fibroblast L929 cells; *EYEC Monograph: 9th European Young Engineers Conference* 102–109, ISBN 978-83-936575-9-9

Awards

- Paweł Sobieszuk – Medal of the National Education Commission
- Maciej Pilarek – Medal of the National Education Commission
- Tomasz Ciach – 1st degree Individual award for Scientific Achievements
- Paweł Sobieszuk – 2nd degree individual award for Organizational Achievements

Division of Kinetics and Process Thermodynamics

Zakład Kinetyki i Termodynamiki Procesowej

Main research areas

- Investigation of microwave regeneration of sorbents
- Investigation of pyrolysis and methane reforming processes
- Experimental and theoretical study on mass transfer processes in multiphase systems
- Formation of multiple emulsions and encapsulation of drugs, living cells, nutrients
- Investigation of release of active substances (drugs) from multiple emulsions
- Cryoprotection and banking of living cells in multiple emulsion-based carriers
- Reduction of membrane fouling by using a Couette-Taylor flow
- Application of Advanced Oxidation Processes (AOP) for abatement of contaminants
- Modeling of gas explosions and pollutants dispersion from industrial safety perspective
- Substance transport (pollutants migration) in simulated biomedical and porous systems
- Investigation of activation of tire pyrolysis char

Major scientific equipment and software

Integrated TG-FTIR System (TG2019 F1-Netzsch)

Porosimeter: ASAP 2020M Millipore-3Flex (Micrometrics)

- Integrated TG-FTIR System (TG2019 F1-Netzsch)
- RC1 reaction calorimeter (Mettler Toledo)
- Porosimeter: ASAP 2020M Milipore-3Flex (Micrometrics)
- Optical microscope, Image Analysis Equipment and Processing (Olympus)
- Rotational rheometer RheolabQC (Anton Paar) and Surface tensiometer (Lauda)
- Laboratory-scale reactor for investigation of reforming and pyrolytic processes
- WLAB – large-scale periodically operated pyrolytic rector
- Laboratory-scale installation for desulphuration of liquid fuels
- Couette-Taylor flow contactor/reactor
- Ozone generators and meters (Trailigaz, Impoz, BMT)

Cooperation with industrial partners

- Łukasiewicz Research Network – New Chemical Syntheses Institute, Poland

WLAB: large-scale periodically operated pyrolytic reactor

Rotational rheometer RheolabQC (Anton Paar)

Projects conducted in 2021

Project type	Title	PI
INGA	Development of the technology of obtaining dimethyl ether in terms of the development of small hydrocarbon deposits	Molga Eugeniusz

Projects granted in 2021 (start in 2022)

Project type	Title	PI
EU Horizon FuelSOME	Multifuel SOFC system with Maritime Energy vectors	Molga Eugeniusz
EU Horizon TITAN	Direct biogas conversion to green H_2 and carbon materials by scalable microwave heaTed catalytIc reacTor for soil Amendment and silicoN carbide production	Cherbański Robert

Excellence Initiative Research University (IDUB-POB) projects conducted in 2021

Project type	Title	PI
BIOTECHMED-2	Emulsion delivery system of therapeutics – cancer treatment assisted by the mechanism of synthetic lethality	Dłuska Ewa

JCR Publications

All DOIs in the following sections contain links leading directly to the listed publications.

Stankiewicz A., Henczka M., **Molga E.** (2021) Teaching chemical engineering in Europe - Developments, dilemmas and practical examples. *CHEM PROCESS ENG-INZ* 42, nr 4, 321–335, DOI:10.24425/cpe.2021.138933

Kuśmierek K., Świątkowski A., **Kotkowski T.**, **Cherbański R.**, **Molga E.** (2021) Adsorption on activated carbons from end-of-life tyre pyrolysis for environmental applications. Part I. Preparation of adsorbent and adsorption

from gas phase. *J Anal Appl Pyrolysis* 157, 1–15, DOI:10.1016/j.jaap.2021.105205

Cherbański R., Franczyk E., **Lewak M.**, **Machniewski P.**, **Molga E.** (2021) Modelling of methane dry reforming over Ni/CaO-Al2O3 catalyst. *CHEM PROCESS ENG-INZ* 42, nr 3, 235–252, DOI:10.24425/cpe.2021.138928

Dłuska E., **Markowska-Radomska A.**, **Metera A.**, **Rudniak L.**, Kosicki K. (2021) Mass transfer of anti-cancer drug delivery to brain tumors by a multiple emulsion-based implant. *AICHE Journal, early access,* DOI:10.1002/aic.17501

Kuśmierek K., Świątkowski A., **Kotkowski T.**, **Cherbański R.**, **Molga E.** (2021) Adsorption on activated carbons from end-of-life tyre pyrolysis for environmental applications. Part II. Adsorption from aqueous phase. *J Anal Appl Pyrolysis* 158, 1–15, DOI:10.1016/j.jaap.2021.105206

Markowska-Radomska A., **Dłuska E.**, **Metera A.**, **Wojcieszak M.** (2021) Multiple emulsions for simultaneous active agents delivery in a skin topical application. *CHEM PROCESS ENG-INZ* 42, nr 3, 263–273, DOI:10.24425/cpe.2021.138930

Małolepszy A., Mazurkiewicz-Pawlicka M., **Kotkowski T.**, **Cherbański R.**, **Molga E.**, Stobiński L. (2021) Synthesis of graphene foams and their sorption properties of n-hexane. *J. Porous Mater.* 28, 1069–1079, DOI:10.1007/s10934-021-01054-8

Machniewski P., **Biń A.**, Kłosek K. (2021) Effectiveness of toluene mineralization by gas-phase oxidation over Co(II)/SiO_2 catalyst with ozone. *Environ. Technol.* 42, nr 25, 3987–3994, DOI:10.1080/09593330.2020.1770868

Molga E. (2021) Special Issues of Chemical and Process Engineering in memory of Professor Jerzy Bałdyga. *CHEM PROCESS ENG-INZ* 42, nr 2, 73–74, DOI:10.24425/cpe.2021.137340

Awards

- Leszek Rudniak, Tomasz Kotkowski – 1st degree team award for didactic achievements
- Tomasz Kotkowski – Distinction for Oral Presentation and active participation in science discussion on "Biologia, Chemia i Środowisko – Spojrzenie Młodych Naukowców. Edycja II" Conference of Young Scientists
- Tomasz Kotkowski – Distinction for active participation in science discussion on "Nowe Trendy w Badaniach Naukowych – Wystąpienie Młodego Naukowca Edycja III" Conference of Young Scientists
- Tomasz Kotkowski – Dean Distinction for Scientific Achievement

Division of Engineering and Dynamic of Chemical Reactors

Zakład Inżynierii i Dynamiki Reaktorów Chemicznych

Main research areas

- Experimental and theoretical analysis of micromixing in the rotor-stator mixer
- Hydrodynamics and mass transfer in a single phase and liquid-liquid agitated systems
- Drop breakage and coalescence in liquid-liquid dispersions with surfactants
- Laminar micromixing of liquids of equal and unequal viscosities
- Supercritical fluid extraction
- Polymer foaming using supercritical fluids
- Subgrid scale scalar variance at high Schmidt numbers – computations and experiments
- Large Eddy Simulation of precipitation process in jet reactor
- Hydrogen recombination in passive autocatalytic recombiners
- Manufacturing and rheology of dense emulsions

Major scientific equipment and software

- T 50 Ultra-Turrax® – IKA rotor-stator mixer
- Rheometer MCR 302 (Antor Paar)
- Surface tensiometer DVA-1 (Sinterface)
- Analytical equipment (HPLC, UV/VIS spectrometer)
- High pressure equipment (reactors, pump)
- CFD software (ANSYS Fluent and OpenFOAM)
- Particle size analysers (Beckman-Coulter LS 13320 and Malvern Zetasizer Nano)

HPC cluster

Rheometer MCR 302 (Anton Paar, Austria)

Cooperation with industrial partners

- Solvay, France
- Instytut Urządzeń Ekstrakcyjnych Sp. z o.o., Poland

Projects conducted in 2021

Project type	Title	PI
NCN SONATA	Identification of mechanisms and testing of the graphene flake production process by direct exfoliation with the use of supercritical carbon dioxide	Henczka Marek

Project type	Title	PI
NCN OPUS	Turbulence modulation in liquid-liquid emulsion systems, taking into account the influence of mixing and mass transport on the course of complex chemical reactions	Jasińska Magdalena

Excellence Initiative Research University (IDUB-POB) projects conducted in 2021

Project type	Title	PI
TechMat-2	Manufacture of oxygen reduction catalysts based on reduced graphene oxide using supercritical fluids	Krzysztoforski Jan
BEYOND-POB-1	Closure problem for complex chemical reactions in turbulent flow regime	Jasińska Magdalena
BIOTECHMED_LAB-1	Spe-ed SFE-2 Supercritical System - research set for processes involving supercritical fluids	Henczka Marek

JCR Publications

All DOIs in the following sections contain links leading directly to the listed publications.

Bojarska Z., **Kopytowski J.**, Mazurkiewicz-Pawlicka M., Bazarnik P., Gierlotka S., **Rożeń A.**, Makowski Ł. (2021) Molybdenum disulfide-based hybrid materials as new types of oil additives with enhanced tribological and rheological properties. *Tribol. Int.* 160, 1–12, DOI:10.1016/j.triboint.2021.106999

Chlanda A., Kowiorski K., Małek M., Kijeńska-Gawrońska E., Bil M., **Djas M.**, Strachowski T., Święszkowski E., Lipińska L. (2021) Morphology and Chemical Purity of Water Suspension of Graphene Oxide FLAKES Aged for 14 Months in Ambient Conditions. A Preliminary Study. *Materials* 14, nr 15, 4108, DOI:10.3390/ma14154108

Kotowicz M., **Jasińska M.** (2021) An improved model for interpretation of micromixing experiment with iodide-iodate method and sulphuric acid. *Chem Eng Res Des* 165, 270–279, DOI:10.1016/j.cherd.2020.10.035

Rożeń A., **Kopytowski J.** (2021) Energetic efficiency of mixing in a periodically reoriented Dean flow. *CHEM PROCESS ENG-INZ* 42, nr 4, 391–410, DOI:10.24425/cpe.2021.138937

Stankiewicz A., **Henczka M.**, Molga E. (2021) Teaching chemical engineering in Europe – Developments, dilemmas and practical examples. *CHEM PROCESS ENG-INZ* 42, nr 4, 321–335, DOI:10.24425/cpe.2021.138933

Tyl G., Kondracki J., **Jasińska M.** (2021) Effect of flow structure and colloidal forces on aggregation rate of small solid particles suspended in aqueous solutions. *CHEM PROCESS ENG-INZ* 42, nr 4, 369–389, DOI:10.24425/cpe.2021.138936

Krzysztoforski J., Khayrat K., **Henczka M.**, Jenny P. (2021) The effect of capillary pumping on the course of cleaning porous materials containing liquid contaminants using supercritical fluids – A pore network study. *CHEM PROCESS ENG-INZ* 42, nr 4, 349–368, DOI:10.24425/cpe.2021.138935

Awards

- Marek Henczka – Golden Chalk for outstanding teaching activities
- Antoni Rożeń – Golden Chalk for outstanding teaching activities
- Jan Krzysztoforski – research scholarship of the Rector of the Warsaw University of Technology for academic teachers

Division of Separation Processes

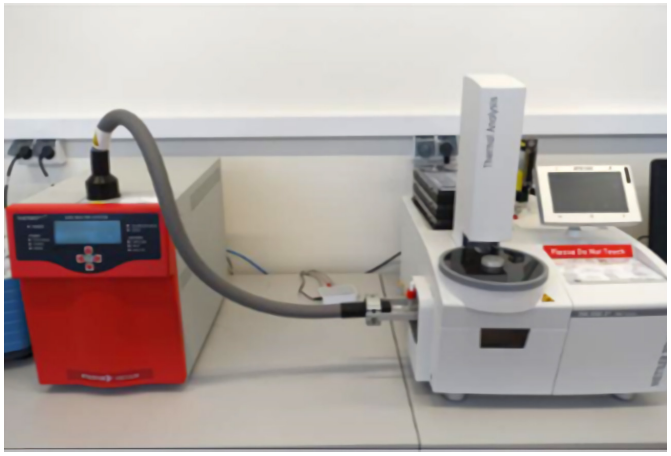
Zakład Procesów Rozdzielania

Main research areas

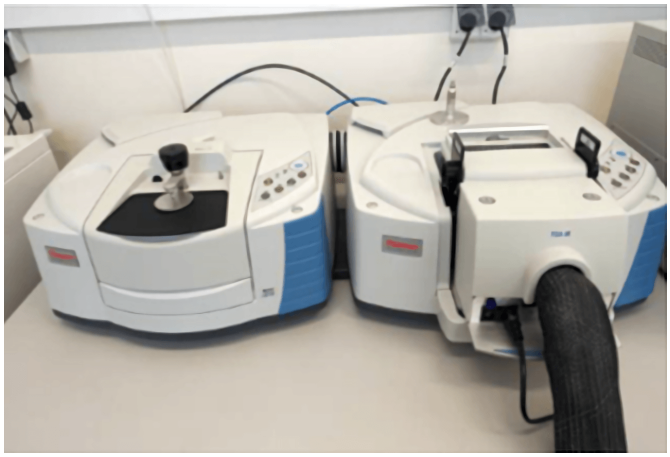
- Design of the production systems (e.g. reactor with rotating discs) of micro- and nanoparticles for special purposes (e.g. as carriers for controlled drug release)
- Utilization of alternative (non-conventional, renewable) energy sources cost and energy optimization of chemical reactors, heat engines, heat pumps and separation systems
- Experimental and theoretical analysis (CFD modelling) of mixing and deagglomeration processes in industrial scale apparatus
- Subgrid scale scalar variance at high Schmidt numbers – computations and experiments
- Mathematical description (modelling and simulation) of crystallization processes
- MoS_2 precipitation process – computations and experiments. Large Eddy Simulation of precipitation process
- Preparation of hybrid nanostructures of molybdenum disulphide/carbon nanomaterials for catalytic and lubricating applications
- Preparation of standardized flake graphene oxide and reduced graphene oxide and their analysis
- Preparation and characterization of powders for drug delivery applications
- Applications of graphene oxide in biomedical applications (drug delivery systems, anticancer treatment, antifungal and antibacterial materials)
- Preparation of metal and carbon nanoparticles for biomedical applications
- Preparation of carbon dots for biomedical applications
- Preparation and analysis materials for Li-ion batteries based on polysaccharides
- Preparation of polymer composites with fillers based on modified graphene oxide and metal oxide nanoparticles for the infrared (IR) radiation shielding
- Preparation and analysis of materials for water purification based on graphene materials
- Membrane methods for ions separation from industrial streams
- Preparation of catalysts for Proton Exchange Membrane Fuel Cell (PEMFCs) based on carbon nanomaterials with metal and metal oxide nanoparticles
- Experimental and theoretical analysis (CFD modelling) of Direct Formic Acid Fuel Cell (DFAFC)
- Application of CFD and laser flow measurement methods in the analysis of the mechanisms of hemolysis, blood rheology, coronary artery disease and periaqueductal leaks
- CFD modelling of catalyst degradation in the industrial processes

Major scientific equipment and software

- System for the production of carbon nanoparticles
- Series of impinging jet reactors with coaxial inlets (T-type reactor) and tangential (V-type reactor) with a syringe pump and a set of filters with different separation levels
- Reactor with rotating discs
- Direct Formic Acid Fuel Cell with a set of flow field plates with different geometry
- High-pressure homogenizer (M-110P, Microfluidics)
- Planetary ball mill (Retsch)
- Three-roll mill (Exakt)
- Ball mill (ICHEMAD-Profarb)
- Disolver with a set of different impellers (ICHEMAD-Profarb)
- Plasma Chamber (Diener)
- Rheometer MCR 302 (Antor Paar)
- Tribology Measuring System PTD-200, PID-44 (Anton Paar)
- HPLC (PERLAN Technologies)
- UV-Vis spectrometer (Thermo Scientific)
- Particle size analyser LS (Beckman & Coulter)
- Particle size analyser DLS – Zetasizer (Malvern)
- Particle Image Velocimetry and Planar Laser Induced Fluorescence (Dantec Dynamics)



TGA/DSC-MS spectrometer (Mettler Toledo/Pfeiffer Vacuum



FT-IR spectrometer (Thermo Scientific)

- Thermogravimetric analyser with differential scanning calorimetry sensor (TGA/DSC 3+, Mettler Toledo) joined with mass spectrometer (Pfeiffer Vacuum) and FT-IR spectrometer (Nicolet iZ10, Thermo Scientific)
- FT-IR spectrometer (Nicolet iS10, Thermo Scientific) with transmission and ATR modes
- X-Ray fluorescence spectrometer – XRF (Epsilon 3XLE, Panalytical)
- Organic elemental analyser CHNS/O (Flash 2000, Thermo Scientific)
- Three-electrode system for electrochemical measurements, including a potentiostat (Biologic)
- Source measure units (Keithley)
- DC power supply
- Retort furnace (Czylok)
- Climate chamber (Memmert)
- CHEMCAD – chemical process simulation software
- AutoCad – a professional CAD program for 2D and 3D design
- ANSYS Fluent – CFD software

Plasma chamber (Diener)

Organic elemental analyzer CHNS/O (Thermo Scientific)

Cooperation with industrial partners

- ICHEMAD-Profarb sp. z o.o., Poland
- Polski Bazalt SA, Poland

Projects conducted in 2021

Project type	Title	PI
NCBR Polsko-Tajwański	Novel hybrid materials based on molybdenum disulfide with enhanced photocatalytic properties for hydrogen evolution reaction	Mazurkiewicz-Pawlicka Marta
NCBR LIDER	Fluorscent carbon nanodots production	Małolepszy Artur
NCN Miniatura	Development of a theoretical model of the decomposition of suspension particles in a tank homogenizer with the use of computational fluid mechanics	Wojtas Krzysztof
NCN OPUS	Investigation of the kinetics of molybdenum disulfide particles to obtain product of desired properties in jets reactors	Makowski Łukasz

Projects granted in 2021 (start in 2022)

Project type	Title	PI
NCN PRELUDIUM	Novel hybrid nanostructures based on molybdenum disulfide and carbon nanomaterials for lubricating applications	Bojarska Zuzanna

Excellence Initiative Research University (IDUB-POB) projects conducted in 2021

Project type	Title	PI
BIOTECHMED-1	Application of computational fluid mechanics and laser flow measurement methods in the analysis of the mechanisms of haemolysis and von Willebrand factor defects occurring in leaks around artificial mitral valves	Makowski Łukasz
TechMat-1	Novel hybrid catalysts based on carbon nanomaterials and molybdenum disulfide for hydrogen evolution reaction	Mazurkiewicz-Pawlicka Marta
ENERGYTECH-1	Development of new channel geometry using computational fluid dynamics to optimize the efficiency of the direct formic acid fuel cell	Małolepszy Artur
TechMat-2	Application of computational fluid mechanics and population balance to model the deagglomeration process of TiO_2 particles in dispersing devices	Orciuch Wojciech
BIOTECHMED_LAB-1	Particle size analyzer	Makowski Łukasz

Project type	Title	PI
BIOTECHMED-3	Methods of estimating the risk of primary and secondary arterial overgrowth accompanying coronary artery disease using computational fluid mechanics, imaging techniques of flow measurement and 3D printing	Wojtas Krzysztof
TechMat-3	Preparation and characterization of $CaCO_3$/GO nanohybrid – a new carrier of active substances	Gierycz Paweł

JCR Publications

All DOIs in the following sections contain links leading directly to the listed publications.

Bojarska Z., Kopytowski J., **Mazurkiewicz-Pawlicka M.**, Bazarnik P., Gierlotka S., Rożeń A., **Makowski Ł.** (2021) Molybdenum disulfide-based hybrid materials as new types of oil additives with enhanced tribological and rheological properties. *Tribol. Int.* 160, 1–12, DOI:10.1016/j.triboint.2021.106999

Jamrozik A., Przewoznik J., Krysiak S., Korecki J., Trykowski G., **Małolepszy A.**, Stobiński L., Burda K. (2021) Effect of grinding and the mill type on magnetic properties of carboxylated multiwall carbon nanotubes. *Materials* 14, nr 14, 1–25, DOI:10.3390/ma14144057

Kozłowski M., **Wojtas K.**, **Orciuch W.**, Jędrzejek M., Smolka G., Wojakowski W., **Makowski Ł.** (2021) Potential applications of computational fluid dynamics for predicting hemolysis in mitral paravalvular leaks. *J. Clin. Med.* 10, nr 24, 1–10, DOI:10.3390/jcm10245752

Mamiński M., Novák I., Mičušík M., **Małolepszy A.**, Toczyłowska-Mamińska R. (2021) Discharge plasma treatment as an efficient tool for improved poly(lactide) adhesive – wood interactions. *Materials* 14, nr 13, 1–12, DOI:10.3390/ma14133672

Lesiak B., Trykowski G., Tóth J., Biniak S., Kövér L., Rangam N., **Małolepszy A.**, Stobiński L. (2021) Effect of microwave treatment in a high pressure microwave reactor on graphene oxide reduction process – TEM, XRD, Raman, IR and surface electron spectroscopic studies. *Materials* 14, nr 19, 1–17, DOI:10.3390/ma14195728

Krzosa R., **Makowski Ł.**, **Orciuch W.**, Adamek R. (2021) Population balance application in TiO_2 particle deagglomeration process modelling. *Energies* 14, nr 12, 1–15, DOI:10.3390/en14123523

Kaczmarek A., Denis P., Krajewski M., Mościcki T., **Małolepszy A.**, Hoffman J. (2021) Improved laser ablation method for the production of luminescent carbon particles in liquids. *Materials* 14, nr 9, 1–17, DOI:10.3390/ma14092365

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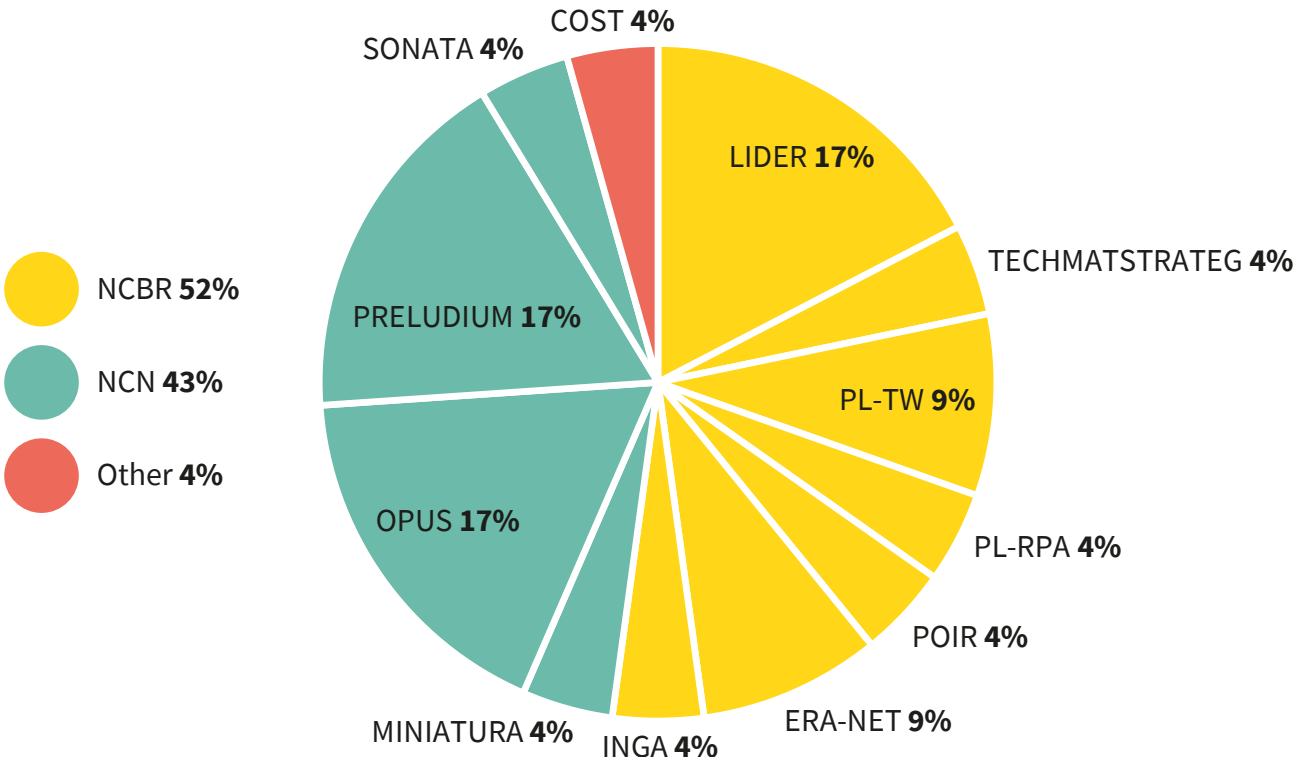
Awards

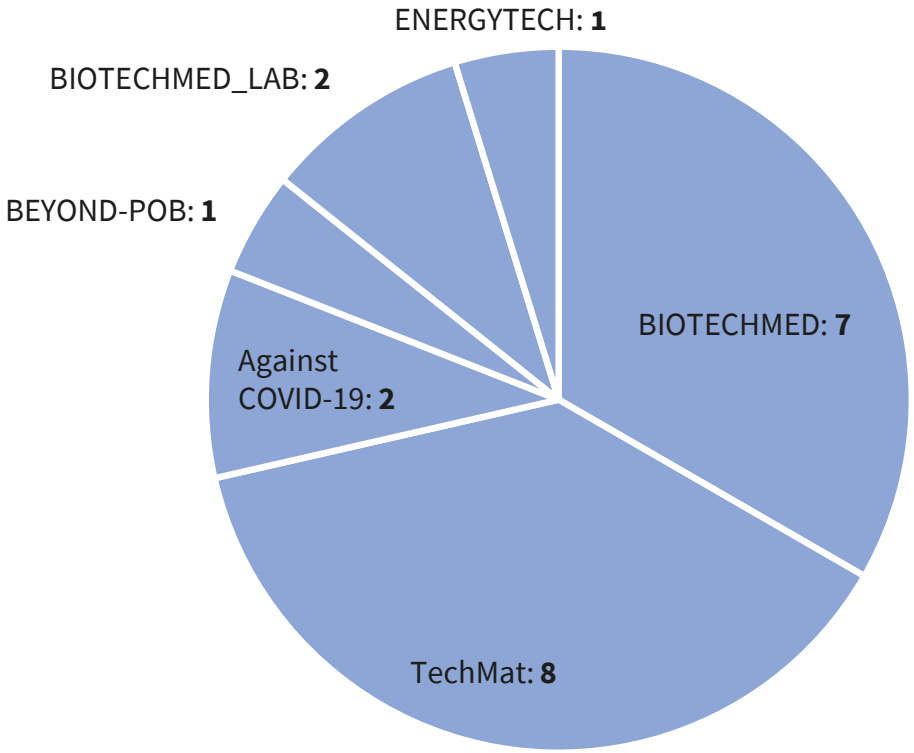
- Wojciech Orciuch – Silver Cross of Merit
- Artur Małolepszy, Marta Mazurkiewicz-Pawlicka, Leszek Stobiński – The M. Wolfke Scientific Award of the Warsaw University of Technology
- Artur Małolepszy – Scholarship of the Minister of Education and Science
- Marta Mazurkiewicz-Pawlicka – Scholarship of the Minister of Education and Science
- Łukasz Makowski, Wojciech Orciuch, Krzysztof Wojtas, Michał Wojtalik, Zuzanna Bojarska – 1st degree Team award for Scientific Achievements
- Krzysztof Wojtas – Golden Chalk for outstanding teaching activities

Statistical data

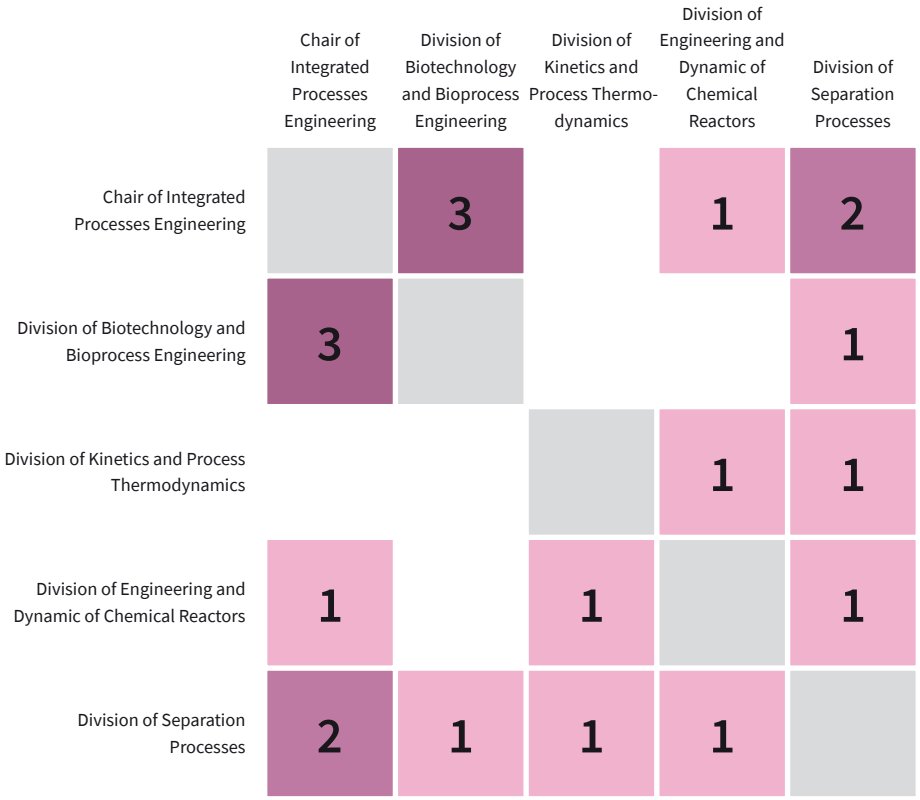
Projects conducted in 2021 (IDUB-POB not included)



Excellence Initiative Research University (IDUB-POB) projects conducted in 2021



Internal Faculty cooperation based on JCR publications



Faculty cooperation within Warsaw University of Technology based on JCR publications