West Pomeranian University of Technology in Szczecin

Research Profile and Technological Capabilities of the West Pomeranian University of Technology in Szczecin in the Development of Innovative Polymeric Wound Dressing Systems

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Ministry of Foreign Affairs
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Visegrad Fund

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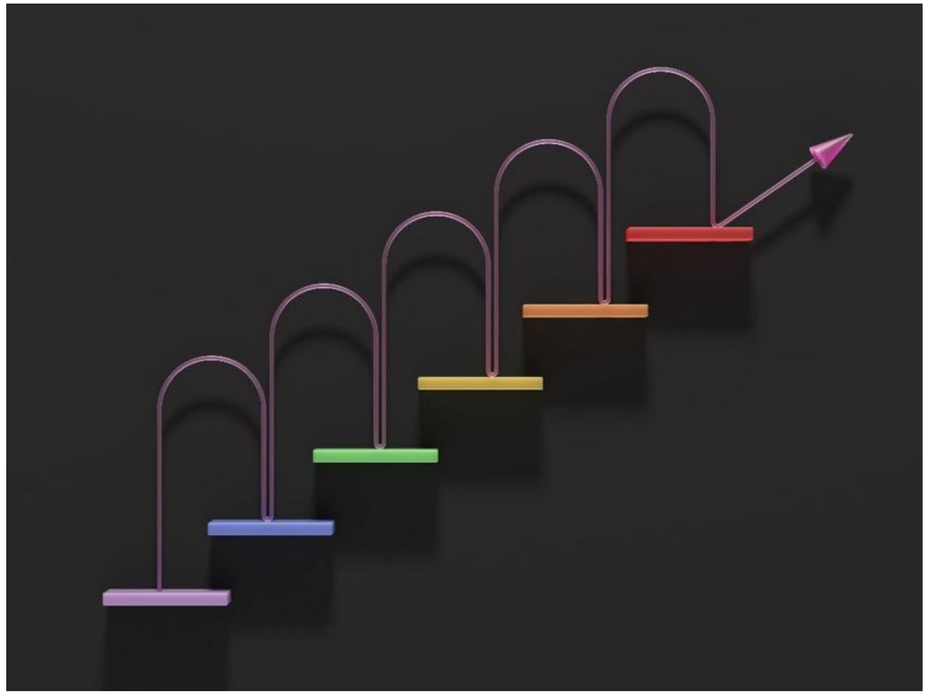
Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

Agenda

- WPUT
- Research Focus
- Methodologies
- Technological Capabilities
- Main Interests
- Future Directions



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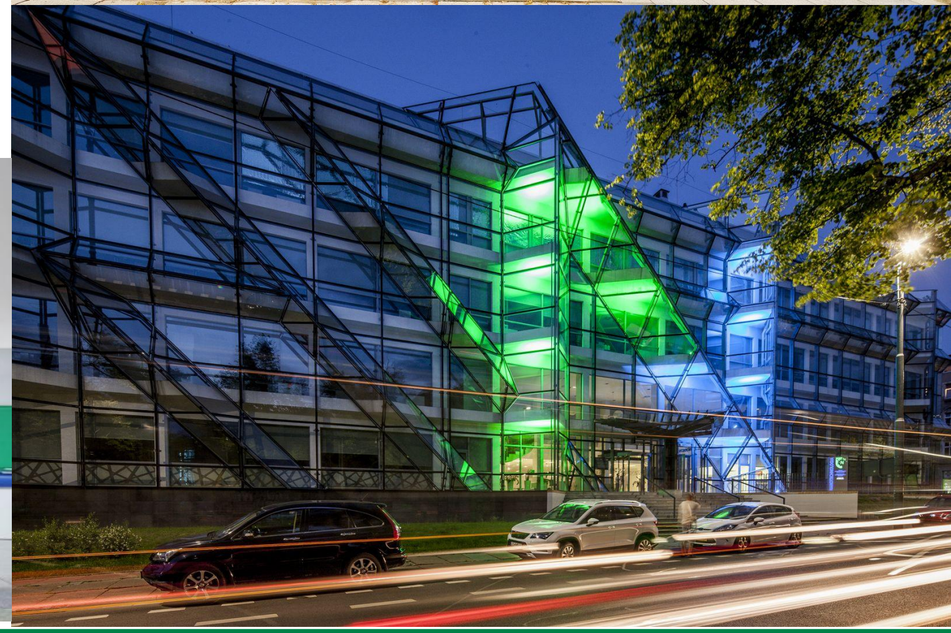
Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

Faculty of Chemical Technology and Engineering

1. West Pomeranian University of Technology in Szczecin

- Public technical university established in 2009 through a merger of two historic institutions (Technical University and Agricultural University)
- Offers bachelor's, master's, doctoral, and postgraduate programs in ~45 fields of study
- Organized into 11 faculties covering engineering, science, technology, agriculture, economics, and environmental disciplines
- Strong emphasis on research, innovation, and international collaboration



1. West Pomeranian University of Technology in Szczecin

Faculty of Chemical Technology and Engineering

- One of the key faculties of WPUT, integrating **chemistry**, **materials science**, and **chemical engineering**

•Strong research profile in:

- **polymer science and advanced polymeric materials**
- **organic synthesis and chemical technologies**
- **biomaterials, pharmaceutical applications, and cosmetic formulations**
- **green chemistry, sustainability, and process intensification**

•Modern laboratory infrastructure enabling:

- polymer synthesis and modification
- hydrogel and film formation
- comprehensive physicochemical and mechanical characterization

•Active involvement in **international research projects**, industrial collaboration, and technology transfer

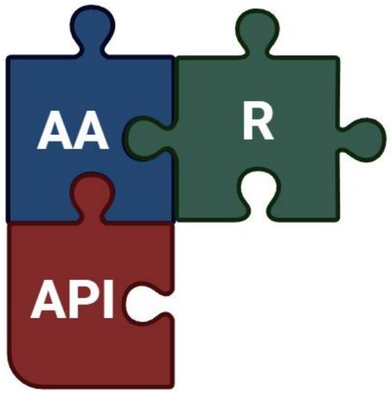
•Commitment to advancing **innovation in materials engineering** for biomedical, environmental, and industrial applications

2. Research Focus

Polymer-based materials for biomedical applications	hydrogels, biodegradable matrices, functional polymer systems
API modification for enhanced delivery and performance	synthesis of amino acid derivatives, esterification routes, salt formation
Ionic liquids & organic salts of NSAIDs	design of drug–counterion systems with improved solubility, permeability, and stability
Eutectic systems and terpene/API ionic hybrids	tuning physicochemical properties to enhance transdermal transport
Electromagnetic field–assisted transdermal delivery	studies on permeability enhancement, molecular mobility, accumulation profiles
Physicochemical and structural characterization	spectroscopy, thermal analysis, rheology, mechanical testing, solubility and diffusion studies
Formulation development for pharmaceutical and dermal applications	transdermal patches, gels, polymer matrices, controlled-release systems

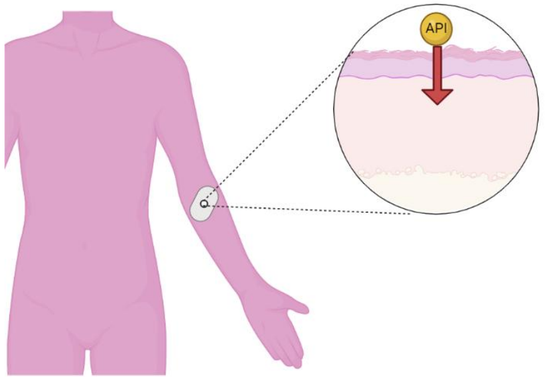
3. Methodologies

1) Chemical Synthesis & API Modification



- Synthesis of **amino acid derivatives**, esters, and salt forms of NSAIDs
- Preparation of **ionic liquids, organic salts, and eutectic systems**
- Structural tuning of APIs to improve solubility, permeability, and stability
- Tailored counterion selection and functionalization strategies

2) Polymer Synthesis & Materials Engineering



- Development of **polymeric matrices, hydrogels, and biodegradable materials**
- Chemical modification of polymer chains (functional groups, crosslinking)
- Preparation of polymer–drug hybrid systems
- Film formation, gel structuring, and prototype dressing fabrication

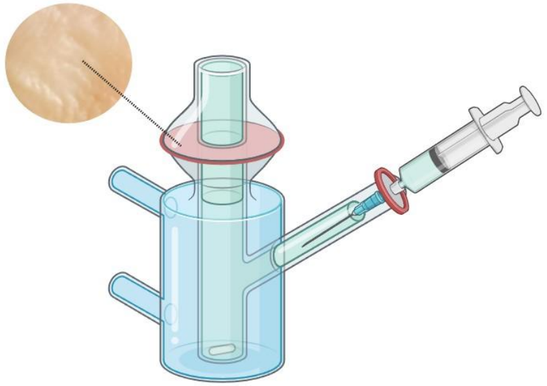
3. Methodologies

3) Physicochemical Characterization

- **Spectroscopic techniques**: FTIR, NMR, UV–Vis
- **Thermal analysis**: DSC, TGA, melting point profiling
- **Mechanical testing**: tensile strength, elasticity, hardness, rheology
- **Morphology & microstructure**: microscopy-based analysis
- Solubility, pKa, partition coefficient, and dissolution behavior studies

4) Permeability & Transdermal Transport Studies

- Franz diffusion cell experiments (synthetic membranes & biological tissues)
- Determination of permeability coefficients, flux, lag time, and accumulation
- Evaluation of EMF impact on skin transport:
  – static, oscillating, rotating, and pulsed electromagnetic fields
- Structure–permeability relationship analysis



3. Methodologies

5) Formulation Development

- Design of dermal and transdermal systems:
  – gels, hydrogels, polymer films, patches, emulsions
- Optimization of stability, viscosity, drug loading, and release profiles
- Compatibility and performance testing of formulations

6) Data Integration & Collaborative Workflow

- Combining chemical, physicochemical, and biological data
- Standardization of analytical methods within research consortia
- Material optimization guided by structure–property correlations

4. Technological Capabilities

Advanced Research Infrastructure at WPUT

The **West Pomeranian University of Technology in Szczecin (WPUT)** provides access to *highly specialized scientific equipment and professional technical support*, enabling advanced research in polymer science, materials engineering, and pharmaceutical technologies.

Faculty & Departmental Capabilities

- Modern laboratories equipped for **polymer synthesis, modification, and formulation**
- Full suite of **physicochemical characterization tools** used in our research projects, including:
  - FTIR, NMR, UV–Vis spectroscopy
  - DSC, TGA, melting point analysis
  - Mechanical testing systems: tensile, rheology, hardness
  - Microscopy and imaging techniques
- Infrastructure supporting **development of hydrogels, biodegradable matrices, transdermal films, and wound dressing prototypes**

4. Technological Capabilities

MATPRO

The Center for Advanced Materials and Manufacturing Process Engineering

MATPRO is the **largest research infrastructure investment in the history of WPUT**, listed on the **Polish Research Infrastructure Map**, and includes:

- **8 specialized laboratories**
- **18 advanced research instruments**, including:
  - **High-resolution HRTEM** (unique in Poland)
  - **ICP-MS coupled with ion chromatography** for speciation analysis
  - **GPC/SEC-MALS** for comprehensive polymer characterization
  - **Confocal white-light laser microscope**

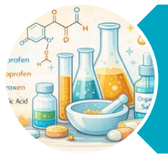
- Access to advanced **spectroscopic, microscopic, analytical, and materials-engineering technologies**

This infrastructure supports research on:

- nanomaterials, biomaterials, nanocomposites
- polymeric and functional materials
- environmentally friendly and circular economy–oriented solutions
- new manufacturing technologies and process optimization

5. Main Interest

Advanced Polymeric Materials for Biomedical Applications



Modified APIs, Ionic Liquids & Organic Salts

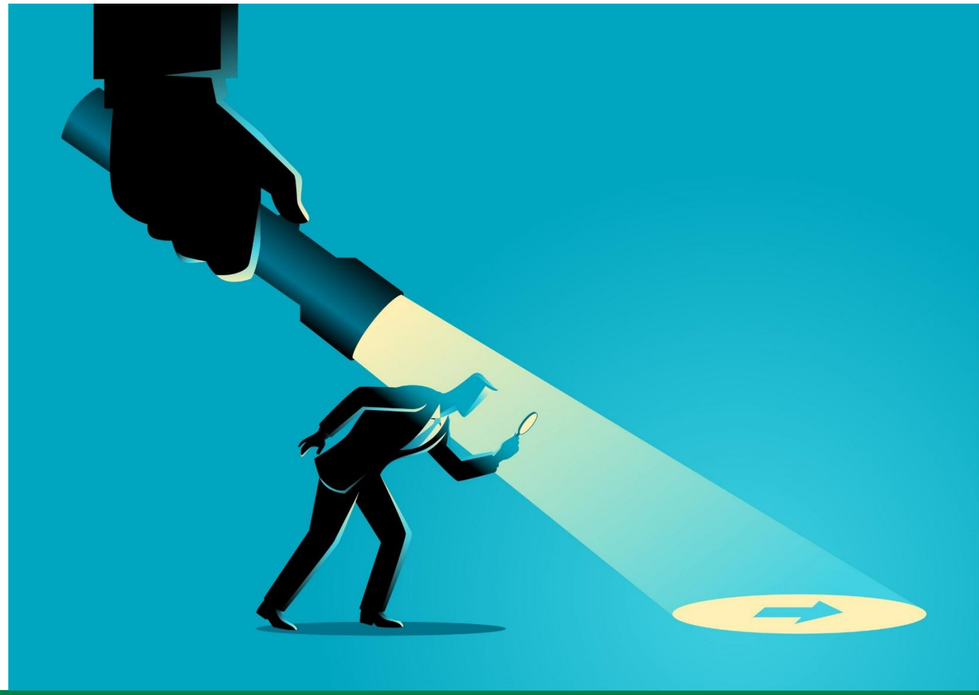
Transdermal & Dermal Drug Delivery

Formulation Science & Prototype Development

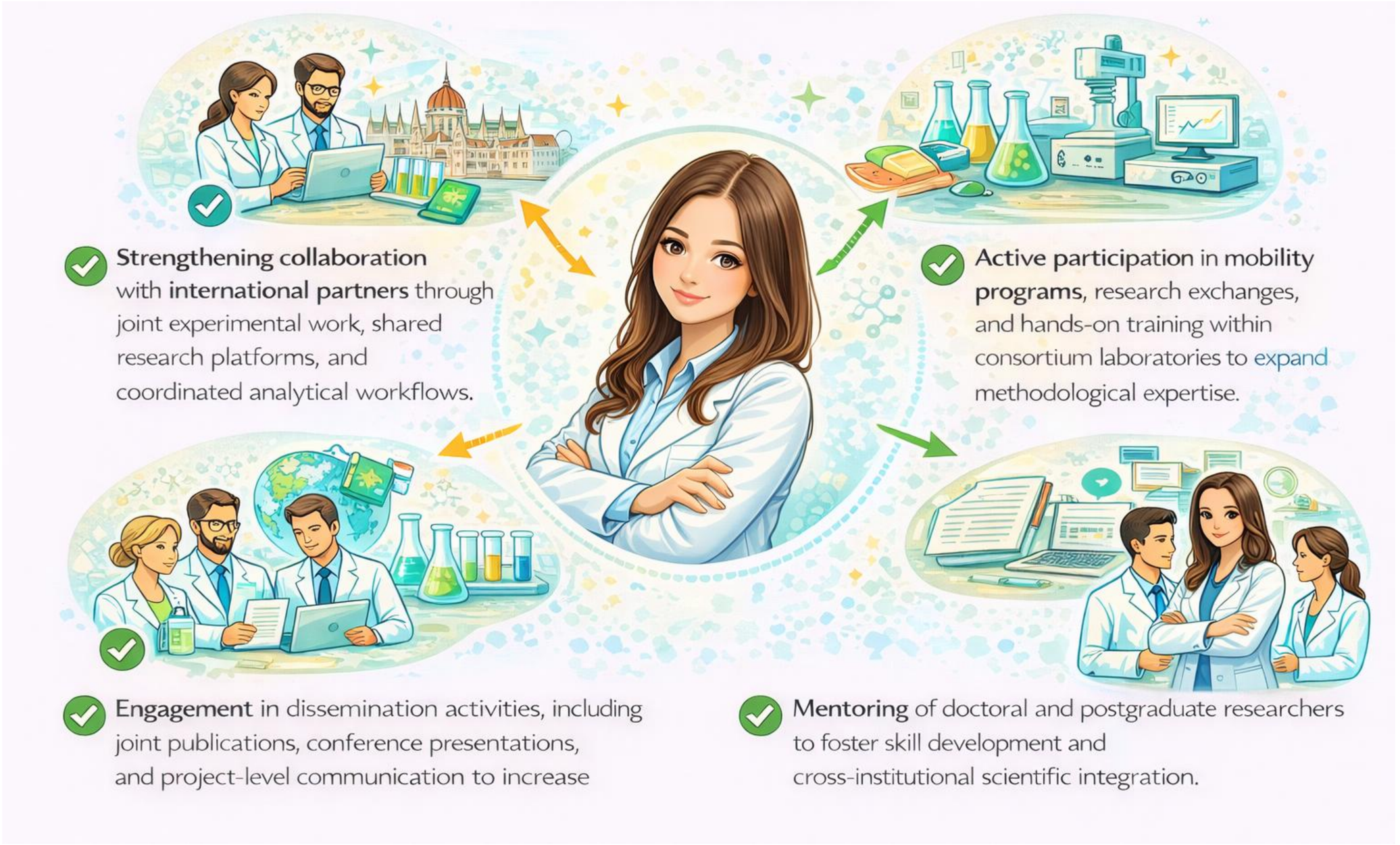
Green & Sustainable Material Technologies

Structure–Property Relationships

Research Collaboration
& Development



6. Future Directions



Strengthening collaboration with **international partners** through joint experimental work, shared research platforms, and coordinated analytical workflows.

Active participation in mobility **programs**, research exchanges, and hands-on training within consortium laboratories to expand methodological expertise.

Engagement in dissemination activities, including joint publications, conference presentations, and project-level communication to increase

Mentoring of doctoral and postgraduate researchers to foster skill development and cross-institutional scientific integration.


See You in Szczecin
on September 2st-4th,
2026