M-ERA.NET **InsBIOration** - Bio-inspired interfaces for the development of next generation degradable multi-phase materials

Partners

Leibniz Instituite of Polymer Research
Coordinator Dr. Cordelia Zimmerer

CNRS Institut Charles Sadron
Dr. Fouzia Boulmedais

National Institute for R&D of Isotopic and Molecular Technologies
Dr. Claudiu Filip

National Institute of Chemistry
Dr. Klemen Pirnat

University of Turku
Dr. Mikko Salomäki

Kunststofftechnik Bernt GmbH
Dr. Carsten Brockmann

Associated partners

BASF We create chemistry

plasmatreat

hamos ADVANCED SEPARATION TECHNOLOGIES

Societal needs demand substitution of processes with high energy consumption or using hazardous substances and reduction of waste by use of fully recyclable or biodegradable materials. The project addresses this by proposing a universal platform for bio-inspired surface and interface design basing on dopamine, a substructure of adhesive mussel proteins. Dopamine (DA), its polymerized form polydopamine (PDA), tannic acid (TA) and analogue compounds adhere to virtually all types of surfaces. Controlled film deposition and modification of functional groups provide ways to create designed surface and interface properties in a facile, eco-friendly way without energy-intensive, material-specific pre-treatments or use of hazardous materials.
A multidisciplinary consortium of researchers and industry aims at developing a portfolio of upscalable technologies for the “green” manufacturing of materials for selected applications (antipathogenic coatings, biodegradable energy sources and polymer-metal hybrids as examples for a broad application range) and their recycling or biodegradation and transferring them to mass production. The project outcome will enable European manufacturers to create sustainable production processes and a circular economy of the materials.

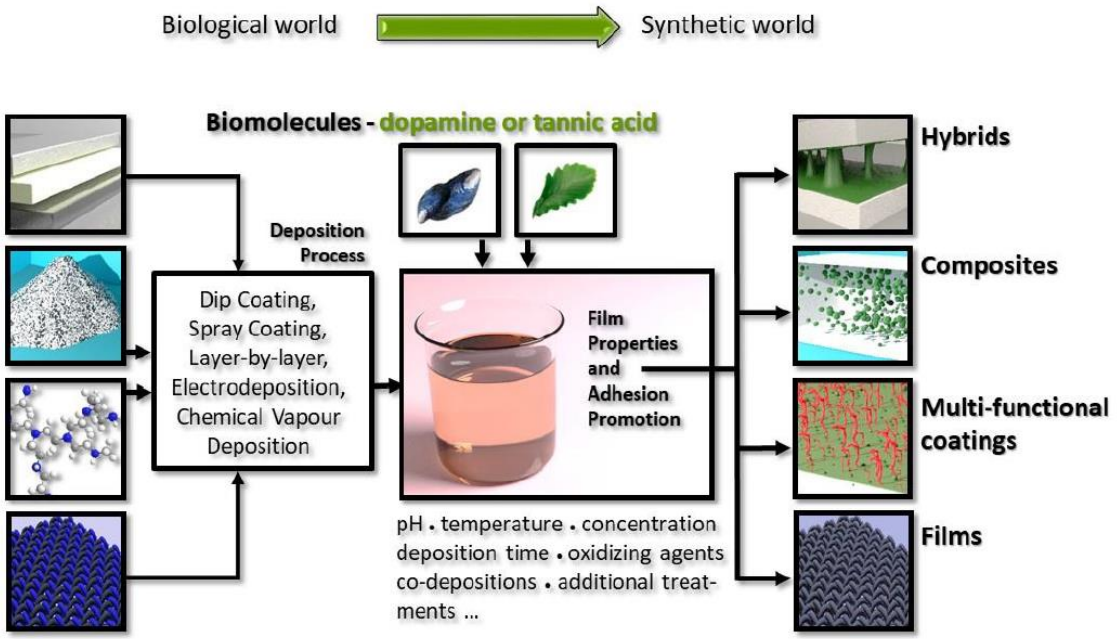
InsBioration

M-ERA.NET

Leibniz-Institut für Polymerforschung Dresden

Challenges

1) Adhesion mechanisms are not fully explored; no universal application method has been developed yet
2) The seemingly simple processing harbours hidden hurdles being difficult to identify and handle
3) The acceptance of the biogenic approach in fields of application that have been technically optimized for years is only slow, rules or regulations are strict, and enterprises have to limit their risk and costs.



Objectives

1) Investigation of fundamentals/mechanisms of biogenic adhesion on molecular scale
2) Development of robust, up-scalable and reproducible deposition techniques for PDA films and investigation of their influence on the film properties
3) Control of the PDA analogue film properties and adhesion by pre- and post-treatments and further modifications to create a generalized interfacial design concept
4) Fabrication of prototypes of multiphase materials with designed surfaces and interfaces for selected applications: antipathogenic coatings, sustainable/biodegradable batteries and supercapacitors and metallization of plastics
5) Study of biodegradability of interfacial adhesion layers for the separation of components of hybrids or composites for their reuse

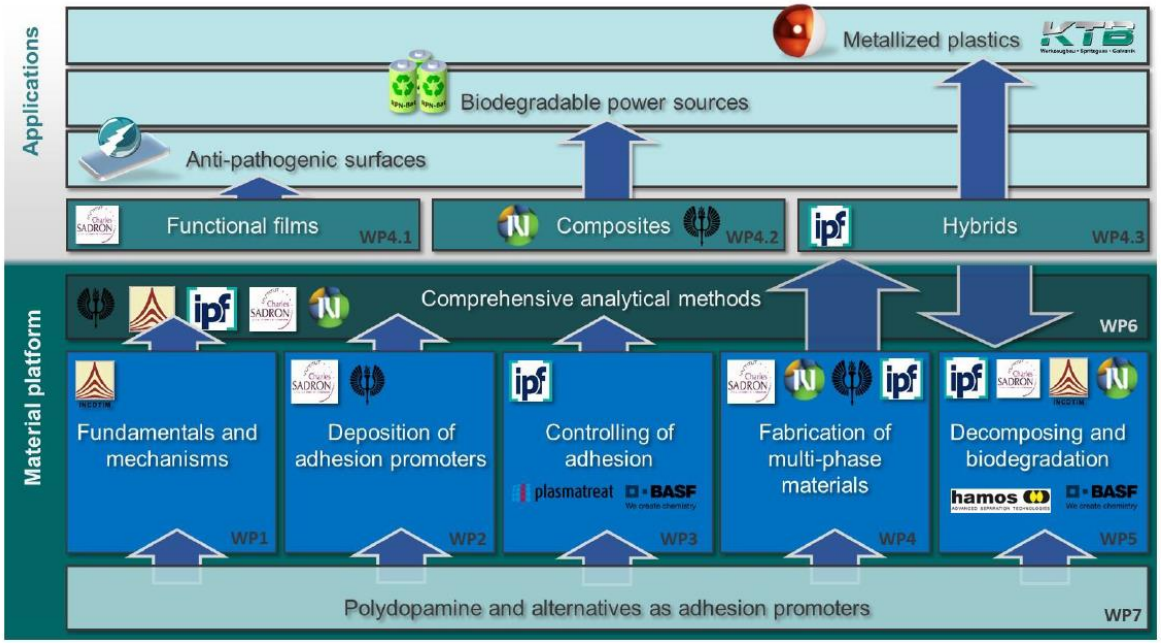
InsBioration

M-ERA.NET

ipf Leibniz-Institut für Polymerforschung Dresden

Desired outcomes

1) The adhesion mechanisms of PDA analogues on polymeric and inorganic materials (metals) and the role of different functional groups are thoroughly investigated and understood.
2) Pristine and post-treated adhesive and functional PDA analogue films are successfully applied by environmentally friendly methods without use of hazardous chemicals and organic solvents. Concepts for process chains can be used for different material classes without material-specific pretreatments. This saves resources and energy; process chains can be downsized
3) Material prototypes for selected applications (antipathogenic coatings, biodegradable batteries / supercapacitors and metallized plastics surfaces) are presented as proof of concept for a generalized material platform for target-oriented applications
4) Strategies are developed to control PDA analogue-promoted adhesion and reverse it "on demand". In this way, reject parts can be disassembled and re-manufactured; hybrid materials can be separated and recycled or biodegraded at the end of their lifetime



InsBioration

M-ERA.NET

Leibniz-Institut für Polymerforschung Dresden