InsBioration

Bio-inspired Interfaces for the Development of Next Generation Degradable Multi-Phase Materials

C. Zimmerer*[,1], A. Drechsler[1], F. Simon[1], F. Boulmedais[2], J. Liebscher[3], C. Filip[3], K. Pirnat[4], J. Bitenc[4], M. Salomäki[5], J. Lukkari[5], C. Brockmann[6]

[*] presenting author, project coordinator
[1] Leibniz Institut für Polymerforschung Dresden e.V. (IPF), Dresden, Germany
[2] CNRS Institut Charles Sadron (ICS), Strasboug, France
[3] National Institute for R&D of Isotopic and Molecular Technologies (INCDTIM), Cluj-Napoca, Romania
[4] National Institute of Chemistry (NIC), Ljubjana, Slovenia
[5] University of Turku (UTU), Turku, Finland
[6] Kunststofftechnik Bernt GmbH (KTB), Kaufbeuren, Germany

Inspired by the byssus filaments of the blue mussel (*Mytilus edulis*), the M-era.NET project 'InsBIOration' aims at **adopting complex natural adhesion concepts to create synthetic interfacial multiphase material designs** within a European consortium of six full and three associated partners.
The consortium works on a universal platform for bioinspired surfaces and interface design based on dopamine and its polymer analogues as well as the plant based material tannic acid and its derivatives [1]. The scientific and transfer goal of the project is to develop highly scalable technologies for the 'greening' of product design and production processes, with focus on exemplary applications, such as anti-pathogenic coatings, biodegradable batteries/supercaps and manufacturing of plastic-metal hybrids in mass production.
Additionally, the development of recycling and biodegradation strategies are investigated.

The focus of the IPF group lies on metallized plastics that are valued particularly in the automotive and sanitary industries for their low cost and high-quality appearance. Using adhesive PDA interphases in the metallization process has a high potential to replace the current technical process based on chromosulfuric acid etching that is environmentally critical, limited to very few polymers, and does not allow component separation after use [3].
Within the project 'InsBIOration', PDA is experimentally tested as a bio-inspired adhesion promoter in a technical scale-up in collaboration with a German industry partner. Beside eco-friendliness, the research targets to a universal metallization process applicable to a broad variety of plastics substrates and controlled detachment of the metal layer, e.g., for recycling [4].

Literature

[1] Project website InsBIOration, www.insbioration.de, accessed 03.03.2025
[2] Petran A, Filip C, Bogdan D, Zimmerer C, Beck S, Radu T, Liebscher J. Oxidative Polymerization of 3,4-Dihydroxybenzylamine-The Lower Homolog of Dopa-mine. Langmuir. 2023 39(15):5610-5620. doi: 10.1021/acs.langmuir.3c00604
[3] Augustine N, Putzke S, Janke A, Simon F, Drechsler A, Zimmerer C. Dopamine-Supported Metallization of Polyolefins-A Contribution to Transfer to an Eco-friendly and Efficient Technological Process. ACS Appl Mater Interfaces. 2022 14(4):5921-5931. doi: 10.1021/acsami.1c19575
[4] Reinhardt M, Drechsler A, Putzke S, Simon F, Zimmerer C. Bioinspired Adhesion Promoters for the Metallization of Polyethylene: A Comparison between Polydopamine and Tannic Acid. ACS Appl. Polym. Mater. 2024 6, 9694−9704. doi.org/10.1021/acsapm.4c01571