Biomaterial Interfaces Division
Room B117-119 - Session BI2-MoA

Functional Biomaterials I: Fabrication and Application

Moderators: Pierluigi Bilotto, CEST GmbH, **Caitlin Howell**, University of Maine

4:00pm **BI2-MoA-8 Low Fouling Marine Coatings Based on Nitric Oxide-Releasing Polysaccharide-Based Hybrid Materials***, Samantha Muhring-Salamone, R. Wanka, A. Rosenhahn,* Ruhr University Bochum, Germany

Biofouling describes the undesired accumulation of bioorganisms on surfaces which is a ubiquitous problem and has a severe environmental and ecological impact.[1–3] Increasing restrictions for biocide-releasing coating result in a growing need for environmentally friendly, sustainable, and biodegradable approaches.[1,4,5] Here, we developed a hybrid material coating based on the polysaccharides alginate and heparin and combined them with amine-containing compounds through sol-gel chemistry. The high amine concentration enables the hybrid material to bind nitric oxide when exposed to high pressure NO. The NO binding was characterized by UV-Vis and ATR-IR spectroscopy, and the NO-releasing kinetics by Griess-assays. Dynamic attachment assays with the marine diatom *N. perminuta* revealed a significant reduction in attachment compared to coatings without NO release capabilities. All coatings readily suppressed the attachment of the marine bacterium *C.marina*. The binding of nitric oxide and the release of nitrogen monoxide species was found to be a promising mechanism to add additional fouling-inhibiting functionalities. All building blocks are environmentally friendly, biodegradable, and biocompatible which makes these protective coatings interesting for environmentally benign marine applications.

[1] J. A. Callow, M. E. Callow, *Nat. Commun.***2011**, *2*, 244. [2] V. Eyring, H. W. Köhler, J. Van Aardenne, A. Lauer, *J. Geophys. Res. D Atmos.***2005**, *110*, 171–182. [3] M. P. Schultz, J. A. Bendick, E. R. Holm, W. M. Hertel, *Biofouling***2011**, *27*, 87–98. [4] D. M. Yebra, S. Kiil, K. Dam-Johansen, *Prog. Org. Coatings***2004**, *50*, 75–104. [5] A. Rosenhahn, S. Schilp, H. J. Kreuzer, M. Grunze, *Phys. Chem. Chem. Phys.***2010**, *12*, 4275–4286.

4:20pm **BI2-MoA-9 Underwater Adhesives Through Chemically-Induced Protein Aggregation***, M. Wilson,* Purdue University*; Q. Lu,* Naval Research Laboratory, Chemistry Division*; K. Nachtrieb, J. Fuller, C. Skogg, E. Yates,* United States Naval Academy*; M. Thum,* ***Christopher So****,* Naval Research Laboratory, Chemistry Division

The common strategy to develop bioinspired underwater adhesives is the incorporation of specific chemistries into synthetic polymers or proteins. However, many organisms—including barnacles—use amyloid-like materials to produce successful adhesives, relying on the aggregation of proteins rather than extraordinary chemistry to achieve durable underwater bonding. Inspired by such systems, we control the aggregation of a commercially available protein, bovine serum albumin, to develop waterborne adhesives that cure underwater. For this, we investigate the action of added chemicals using gel inversion tests, differential scanning calorimetry, rheometry, and infrared spectroscopy. We find that added chemical constituents influence the unfolding, aggregation kinetics, and final structure of the solid protein material in different ways. Multiple chemicals can be added to a formulation to provide synergistic effect, forming a solid material within minutes at room temperature underwater. These adhesives produce bond strengths comparable to many synthetic bioinspired adhesives when tested by lap shear after exposure to dry and wet conditions. The ease with which these glues can be fabricated paves the way for opportunities with other commercial proteins and curing agents as a new avenue to produce scalable underwater adhesives.

4:40pm **BI2-MoA-10 Analysis of a Pharmaceutical Formulation using Orbitrap-SIMS***, Birgit Hagenhoff,* Tascon GmbH, Germany*; J. van Rüschen,* University of Muenster, Germany*; D. Breitenstein,* Tascon GmbH, Germany*; A. Pirkl,* IONTOF GmbH, Germany*; G. Winkler,* Tascon GmbH, Germany

Pharmaceutical formulations are subject to high quality standards which must be checked at regular intervals. A pharmaceutical review of the composition of the active ingredients is part of the quality assurance of pharmaceutical companies. For this purpose, also mass spectrometric methods are applied.

Orbitrap-SIMS ("3D-Orbi-SIMS") is a comparably new mass spectrometric technique introduced in 2016 [1]. It is a powerful tool to identify organic as well as inorganic components on the surface of a solid sample. Furthermore, it allows the detection of the lateral distribution of these analytes with high mass resolving power. To perform Orbitrap-SIMS on a sample, typically no pre-separation of analytes is necessary.

In Orbitrap-SIMS, a primary ion beam is directed at the sample surface, causing the sample to emit secondary ions. These ions are then mass separated and detected by an Orbitrap mass analyzer. By rastering the surface with the primary ion beam, 2D images reveal the lateral distribution of the molecules.

In this study, the application of Orbitrap-SIMS on selected pharmaceutical samples is tested. The focus is set to the mass spectrometric identification of the active agents as well as on the revealing of their lateral distribution in a cross-sectioned tablet.

One type of sample examined was composed of two active ingredients: Hydrochlorothiazide and Candesartancilexetil. Both active agents belong to the group of antihypertensives: Hydrochlorothiazide is a thiazide diuretic, whereas Candesartancilexetil is an angiotensin receptor blocker [2].

Identification was performed by the acquisition of full mass spectra of the sample followed by data evaluation using Principal Component Analysis (PCA). The detected SIMS-induced fragmentation pattern was in line with the fragmentation behaviour of the active agents determined by tandem mass spectrometry.

At last, mass spectrometric imaging of the sample was performed in order to reveal the lateral distribution of the active components within the sample.

The results give a glimpse into the potential of Orbitrap-SIMS to solve analytical questions in pharmaceutical industry.

Sources:

[1] Passarelli MK, Pirkl A, Moellers R et. al. The 3D OrbiSIMS-label-free metabolic imaging with subcellular lateral resolution and high mass-resolving power. Nat Methods. 2017 Dec;14(12):1175-1183.

[2] Carey RM, Moran AE, Whelton PK. Treatment of Hypertension: A Review. *JAMA*. 022;328(18):1849–1861.

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