# MM 32: Biomaterials and Biological materials I

Time: Wednesday 10:15–11:45 Location: TC 006

**Topical Talk** MM 32.1 Wed 10:15 TC 006

**Structure-property relations in biological composite materials: An inspiration source for synthetic materials** — •Helge-Otto Fabritius[1], Joachim Enax[2], Xia Wu[3], Matthias Epple[2], and Dierk Raabe[1] — [1]Max-Planck-Institut für Eisenforschung, Düsseldorf, Germany — [2]University of Duisburg-Essen, Essen, Germany — [3]University of Paderborn, Paderborn, Germany

From a materials science point of view, biological materials are hierarchically structured nano-composites optimized through evolution to perform vital functions within the specific eco-physiological strains of living organisms. Most of them consist of a matrix of structural biopolymers like collagen in vertebrate bones and teeth, chitin in arthropod exoskeletons, or cellulose in plants and various other organic and inorganic constituents. Their physical properties are adapted to the specific functions of the materials and can be very diverse, which is caused by structural and chemical alterations at different hierarchical levels. Understanding the structure-property relations and thus the design principles of biological materials is a valuable source of inspiration for the development and improvement of synthetic materials with tailored properties. Using a combination of experimental and theoretical approaches, we explore this potential in a variety of natural materials like shark tooth enameloid as a biological model for dental materials with improved performance and durability and photonic crystals formed by the arthropod cuticle as inspiration for the development of new, optically active materials.

**Topical Talk** MM 32.2 Wed 10:45 TC 006

**Towards bioinspired adaptive composites using responsive microcapsules** — •André R. Studart — Complex Materials, Department of Materials, ETH Zurich, 8093 Zurich, Switzerland

Biological materials exhibit dynamic self-healing and adaptive functionalities that arise from the coordinated action of living cells. Despite the unparalleled complexity of biological systems, major efforts have been made to generate engineered microcompartments that partly replicate just a few key features of the fascinating dynamic response of living cells. In this talk, I will present our recent efforts to create chemically- and mechanically-responsive microcompartments using templating double emulsions made by a microfluidic technique. In the first part of the talk, I will present tools to obtain polymer-based capsules with predictable size and shell thickness, as well as tunable mechanical behavior and shell microstructure. Such microcapsules are incorporated into polymer matrices to generate composites with self-healing and adaptive properties. In the second part, I will describe a general strategy to create multifunctional colloidosomes that can release cargo on-demand in response to an external chemical trigger. This is achieved by reversibly trapping cargo molecules inside the colloidosome or by implementing gating properties to the capsule wall using responsive polymer shells. While the capsules obtained remain very far from reaching the responsiveness of truly dynamic biological systems, the level of geometrical and materials control enabled by microfluidics makes it a promising platform for the creation of advanced microcompartments for future capsule-based adaptive materials.

MM 32.3 Wed 11:15 TC 006

**Banksia - fire-triggered seed release** — •Michaela Eder[1], Vanessa Schoeppler[1], Jessica Huss[1], David Merritt[2], and Peter Fratzl[1] — [1]MPI for Colloids and Interfaces, Potsdam, Germany — [2]Botanical Gardens and Park Authorities, Perth, Western Australia

After germination plants are bound to a certain location which requires functionality of the material forming the plant body. Fascinating examples can be found in extreme environments such as fire-prone areas: the woody follicles of the Australian genus Banksia encapsulate and store seeds in the plant canopy, in some cases for more than 15 years, until they are released during/after fire. This requires both long-term (dimensional) stability and the ability for seed release triggered by fire. The two valves of the follicles are connected by a zone of interdigitating cells sealed with a wax/resin. Heat causes initial opening along this zone, but opening does not seem to be controlled by the melting temperature of the wax/resin. Instead the complex micro- and ultrastructure appears to control a 2-stage opening process. After initial opening by fire, wetting and drying cycles are required for seed release. This presumably ensures optimal conditions for germination are present (ie water availability) before seed release. From a biomimetic point of view detailed knowledge about material properties of the follicles can be useful for eg the development of environmental friendly, biomimetic flame retardants, the design of dimensional stable bio-based construction materials or the development of robust fire-sensors which may function as actuators.

**15 min. break**