

BIO-INSPIRED MATERIALS

Organizers: Naoe Hosoda, National Institute for Materials Science
Alfred J. Crosby, University of Massachusetts Amherst

Nature provides awe-inspiring lessons in designing materials structures from simple building blocks to achieve necessary performance. In these designs, ubiquitous forces are utilized to impart control of both structure and performance. For example, van der Waals and capillary forces are used by geckos to achieve a unique balance of adhesion and locomotion through a differentiated hierarchy in their foot structure. In this session, speakers will discuss current efforts to learn from Nature not only in the design of materials but also in concepts that lead to fundamental understanding of materials properties and the implementation of these materials into advanced applications. Biomimicry at the molecular, nano-, micro-, and macro- length scales will be discussed, thus highlighting the broad frontiers of engineering that offer both opportunities and challenges.

Darrin Pochan will start the session with a discussion of molecular level engineering, using peptidic self-assembly to develop hierarchical building blocks that can be used in the construction of soft materials. These materials have immediate application in bio-related technologies, but their structures and the associated discovery of bio-related principles for materials assembly broaden their impact on materials development for a variety of fields. Yuya Oaki will next introduce how inorganic materials, such as robust crystalline shells, can be developed using concepts of biomineralization. In these methods, organic molecules guide the placement of inorganic building blocks into structures with functions that would not be realized in the inorganic materials' native state. Nacre is a wonderful natural example of such structures. Akira Saito will address how concepts, such as structural coloring displayed in the wings of butterflies, can be used to create robust coatings with multi-functionality. In particular, this discussion will provide insight into methods and principles behind the scaling of bio-inspired solutions into manufacturing-level processes. Finally, Shu Yang will discuss how polymer gels and organic-inorganic hybrid materials can be designed to use processes found in nature, such as mechanical instabilities, to control pattern and structure formation for use in a variety of applications including, controlling wetting, adhesion, and optics. The session will conclude with a panel discussion where the experts address questions related to the future prospects and challenges of using bio-inspired materials design to meet engineering demands.