



Distinguished LECTURE SERIES

Multiscale Smart Materials by Design - connecting simulation, experiment and synthesis across multiple scales

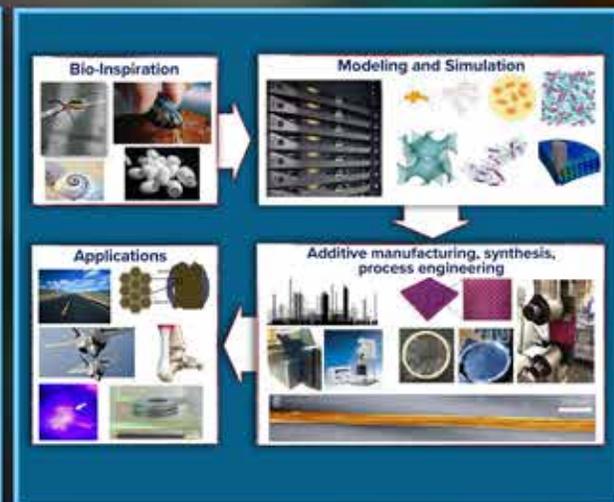
Presented by:

Prof. Markus Buehler

McAfee Professor of Engineering and Head of the Civil and Environmental Engineering Department, Massachusetts Institute of Technology (MIT)



**MAR 20
2018
11 a.m.**
IN THE JUNKER CENTER



Office of Naval Research
875 N. Randolph St., Arlington, Virginia
Bobby Junker Executive Conference Center, 14th Floor

Multiscale Smart Materials by Design - Connecting Simulation, Experiment, and Synthesis Across Multiple Scales

What if we could design materials that integrate powerful concepts of living organisms—self-organization, the ability to self-heal, tunability and an amazing flexibility to create astounding material properties from abundant and inexpensive raw materials? This talk will present a review of bottom-up analysis and design of materials for various purposes—as structural materials, such as bone in our body, or for lightweight composites, for applications as coatings, and as multifunctional sensors to measure small changes in humidity, temperature or stress. These new materials are designed from the bottom up and through a close coupling of experimental and powerful computation as we assemble structures, atom by atom. Materiomics investigates the material properties of natural and synthetic materials by examining fundamental links between processes, structures and properties at multiple scales, from

nano to macro, by using systematic experimental, theoretical or computational methods. We review case studies of joint experimental-computational work of biomimetic materials design, manufacturing and testing for the development of strong, tough and smart mutable materials for applications as protective coatings, cables and structural materials. We outline challenges and opportunities for technological innovation for biomaterials and beyond, exploiting novel concepts of mathematics based on category theory, which leads to a new way to organize hierarchical structure-property information, as well as the design of algorithms based on machine learning and artificial intelligence. Altogether, the use of a new paradigm to design materials from the bottom up plays a critical role in advanced manufacturing, providing flexibility, tailorability and efficiency.

ABOUT Professor Markus Buehler

Markus J. Buehler is the McAfee Professor of Engineering at MIT, the PI of MIT's Laboratory for Atomistic and Molecular Mechanics, and Head of Department of Civil and Environmental Engineering. In his research, Buehler pursues new modeling, design and manufacturing approaches for advanced materials that offer greater resilience and a wide range of controllable properties, from the nano to the macroscale. He has published several hundred scholarly articles on materials design and modeling, and authored several books. His most recent book, "Biomateriomics," presents a new paradigm for the analysis of bio-inspired materials and structures to devise sustainable technologies, and for using a mathematical categorization approach that connects insights from disparate fields such as materials and structures to music and language.

Buehler has received numerous awards and recognitions, including Harold E. Edgerton Faculty Achievement Award for exceptional distinction in teaching and in research or scholarship, the highest honor bestowed on young MIT faculty. Other major

awards include the Alfred Noble Prize, the Leonardo da Vinci Award, the Thomas J. R. Hughes Young Investigator Award, and many other recognitions from professional societies. He is also recipient of the National Science Foundation CAREER award; the United States Air Force Young Investigator Award; the Navy Young Investigator Award; the Defense Advanced Research Projects Agency (DARPA) Young Faculty Award; and the Presidential Early Career Award for Scientists and Engineers (PECASE), the highest honor bestowed by the United States government on outstanding scientists and engineers in the early stages of their careers. He was an invitee at several National Academy of Engineering Frontiers of Engineering Symposia and has delivered several plenary lectures at this forum. He is a fellow of the American Institute for Medical and Biological Engineering and NANOSMAT Society. In 2016, he was awarded the Feynman Prize in Nanotechnology. He currently is the president-elect of the Society of Engineering Science, where he will begin his term as president in 2019.