Bio-inspired Methods to Self-Assemble 3D Micro-/Nano-Structures for Energy Harvesting

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Abstract

No matter how complex the structures of a living organism are, the building blocks of such a structure are often amazingly simple. Self-assembly at the micro- and nanoscales is a powerful tool to construct such complex structures. Water, among all things, plays a critical role in the self-assembling processes. In particular, such processes often involve surface phenomena, such as capillary interactions and surface adhesion. Many scientific issues of these surface phenomena during self-assembly can be best understood using the mechanics approach. In this talk, I will demonstrate that mechanics can indeed be a useful tool to help understand surface phenomena-driven self-assembly by considering the self-assembly of a 3-D photovoltaic device made of thin silicon foil. A model has been developed to help identify the mechanisms controlling the behavior of these processes. Critical parameters emerge naturally from the analysis which can be used to guide the device formation and manufacturing of nanoscale components.

Bibliography

Dr. K. Jimmy Hsia is Professor of Mechanical Science and Engineering at the University of Illinois at Urbana-Champaign. He received his B.S. in Engineering Mechanics from Tsinghua University, Beijing, China, and his Ph.D. in Mechanical Engineering from MIT. He has been a Visiting Scientist at the Max-Planck Institute for Metals Research in Stuttgart, Germany, a Visiting Professor at Nagoya University in Japan, and a Visiting Professor at Shenyang National Laboratory for Materials Research in China. His research interests include deformation and failure mechanisms of materials at ambient and elevated temperatures, mciro/nanomechanics of materials, and nanoscale phenomena in biomaterials. He has served as Guest Editor/Co-Editor for several special issues of Materials Science and Engineering. He is recipient of an NSF Research Initiation Award,

a Max-Planck Society Scholarship, and a Japan Society for Promotion of Science Fellowship. From 2005-2007, Jimmy Hsia served as Founding Director of Nano and Bio Mechanics Program in the Directorate for Engineering at the National Science Foundation (NSF). At NSF, he was actively involved in establishing the initiative of "Cellular and Biomolecular Engineering" for the new Office of Emerging Frontiers in Research and Innovation. He also participated in the Interagency Modeling and Analysis Group (IMAG) involving NSF, NIH, NASA, and DoE programs, and other multi-agency activities. Jimmy Hsia returned to teaching at the University of Illinois in Fall of 2007. He has been named Associate of Center for Advanced Study at UIUC since August of 2008.