

Seminar Announcement

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Green Hall, Room 0120
3:00 PM

Next Generation Programmable Soft Materials: From Photonics to Self-Healing Devices

Abstract: Many globular and structural proteins have repetitions in their sequences or structures. However, a clear relationship between these repeats and their contribution to the physical properties in materials remains elusive. We propose a new approach, called Genomechanics, for the design and production of synthetic polypeptides that comprise one or more tandem copies of a single unit with distinct amorphous and ordered regions. Our designed sequences are based on a structural protein, produced in squid suction cups, that has a segmented copolymer structure with amorphous and crystalline domains. Segmented structure of the protein shows soft segments with self-healing capability and hard segments that self-assemble into nano-confined domains to reinforce the material. For the first time, we designed and demonstrated that the genomechanics approach can control the percent of crystallinity in these materials. Hence, structure-property relationship for protein based programmable materials is established for enhanced light matter interactions (e.g., control of thermo-optic coefficient, refractive index, optical loss/gain) as well as for tunable elasticity (e.g. control of toughness, young modulus, strength), which lays the groundwork for eco-friendly, flexible device design. As an ideal candidate of bio-derived material, our biopolymer will find use in multiple fields including in medicine, textile, and photonics.

Bio: Dr. Melik Demirel is a tenured Professor of Engineering, Materials Research Institute and Huck Institutes of Life Sciences at the Pennsylvania State University. Over the last two decades, Professor Demirel and his research team have focused on developing functional nanoscale biomimetic materials. His team designed, fabricated and synthesized advanced materials by studying the functional transitions of biomimetic systems, both computationally and experimentally. Prof. Demirel's achievements have been recognized, in part, through his receipt of a Young Investigator Award from the Department of Defense, an Alexander von Humboldt Fellowship, as a Wyss Institute Visiting Scholar at Harvard University, an Institute for Complex Adaptive Matter Junior Fellowship, The Nicholas and Gelsa Pelick Biotechnology Innovation Award and the Pearce Development Professorship, and a Penn State Engineering Alumni Society Outstanding Research Award. Prof. Demirel received his PhD from Carnegie Mellon University, Pittsburgh, USA, and BS/MS degrees from Bogazici University, Istanbul, Turkey.

Host: Dr. Lan Yang