DEPARTMENT OF CHEMISTRY AND ENVIRONMENTAL SCIENCE
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TIME: 1:00PM-2:20PM

GUEST SPEAKER

Dr. Melik Demirel
Huck Endowed Chair Professor in Biomimetic Materials
Penn State University
State College, PA

TOPIC

"Bio-enabled polymers"

ABSTRACT

Self-assembling proteins are valuable building blocks allowing the construction of materials with versatile chemical properties and functions based on their tertiary and quaternary protein structures. Well-studied motifs from tandem repeat proteins (such as silk, elastin, collagen, keratin, resilin, and squid ring teeth-SRT) have been frequently used in combination to create multifunctional materials for diverse applications. Besides their extraction from natural sources, these biopolymers are produced using genetically modified organisms. Over the four billion years of evolution, living organisms produce a variety of biopolymers for specific metabolic functions, mechanical supports or sensing environment. Such materials and their engineered derivatives via directed evolution can exhibit extraordinary physical responses that have not been observed in synthetic or inorganic materials. Those properties and responses selected via directed evolution can play significant roles in achieving novel functionalities and fabricating various devices. Recently, we discovered that tandem repeat biopolymers can be tuned for predefined macroscopic symmetries, which cannot be obtained in traditional materials engineering, by controlling their packing symmetry or order during assembly via directed evolution. Our goal is to create self-assembling materials with unprecedented control over their physical properties using synthetic biology. Moreover, exquisite knowledge of structure-property relationships in proteins will aid in the design of composites materials (organic/inorganic) with desired properties for building devices with novel functionalities, which are difficult to achieve or previously unattainable. Our approach for composite materials is based on directed evolution to screen molecular morphology of polymeric proteins against layered materials. The composites can be designed to exhibit a variety of unusual physical properties (e.g., ultra-high thermal storage at room temperature, or thermal conductivity switch, as well as self-healing soft-robotics). In this talk, we will discuss (i) sequence-structure-property relationships for tandem repeat proteins that can be genetically engineered, (ii) self-assembly of hierarchical organic/inorganic structures

that can provide dynamic and time-responsive materials, and (iii) experimental and computational tools to predict performance of genetically engineered materials.

BIO

Prof. Demirel is a scientist and innovator with expertise in biotechnology, nanotechnology and materials science. He is a member of National Academy of Inventors. His research focuses on recent advances in biotechnology and materials science for biosynthesis of environmentally sustainable materials (biodegradable, self-healing, self-repairing) that are excellent alternative to plastics. He is the co-founder of Tandem Repeat Technologies, www.tandemrepeat.com that creates smart textiles from sustainable sources (>$3M funding by DoE and investors). He is the director of CRAFT Center (with 23 faculty, http://www.mri.psu.edu/craft/) at Penn State. He has published over 120 articles in refereed journals with including high impact publications (Nature Materials, Nature Nanotechnology, PNAS, Nature Biotechnology, Physical Review Letters), conference proceedings and patents. He received numerous national and international awards as well as educated over 50+ students as a faculty member at Penn State. Details of Prof. Demirel's biography are available in the following video: http://www.peoplebehindthescience.com/dr-melik-demirel/.

CV and abstract from Prof. Melik Demirel at Penn State University (http://www.personal.psu.edu/mcd18/)

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