Seminar Announcement

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Molecular Biomimetics – Bridging Biology with Solid Materials by Engineered Peptides: Foundations for Nanotechnology & Nanomedicine

Protein-solid interactions and assembly of proteins on surfaces is utilized in many fields to integrate biomolecules and their diverse, genetically-controlled functions with engineered solid substrates, including nanoparticles, quantum dots, nanorods, thin films and bulk materials. Examples include bioelectronics, biosensors, and bioimplants. In biology, proteins are the major biopolymers that enable dynamic organic systems but they also catalyze mineralization, growth, and intricate hard tissue formation with complex multifunctional properties. These are all desirable merits in engineered systems but currently impossible to achieve. Controlling proteins at bio-solid interfaces relies on establishing key correlations between primary sequences and resulting molecular interactions that follow spatial organizations on substrates. Using combinatorial mutagenesis, similarity analysis in bioinformatics and rational design principles, our Center engineers short peptides (7-25 amino acids long) by controlling their folding patterns and, hence, tailoring the molecular interactions that leads to a variety of addressable self-assembled peptides (SAP) nanostructures. The peptides are tailored via simple point and domain mutations to control fundamental interfacial processes, including initial binding and molecular recognition, surface aggregation and growth kinetics, and intramolecular interactions leading to self and targeted assembly. Tailoring short peptides and their molecular interactions offers versatile control over molecular well-defined surface properties essential in building engineered, chemically and electronically rich, bio-solid interfaces. As demonstrated, peptides alone, or in chimeric forms, as bifunctional constructs can bridge nanosolids to form molecularly hybrid systems for a variety of biophotonics and bioelectronics implementations as well as solution and surface biofunctionalization for implants (to enhance osteointegration and nano-fouling surfaces), nanoparticle and thin film mineralization, for tissue regeneration) and bifunctional chimeric enzyme-peptide conjugates. This presentation will summarize recent advances and provide future prospects in proof-of-principle demonstrations at the confluence of biology and solid materials.

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