Molecular Biomimetics – Designing the Interfaces and Surfaces via Molecular recognition by Engineered Peptides

Mehmet Sarikaya*
Professor of Materials Science & Engineering and Chemical Engineering Director of GEMSEC,
Genetically Engineered Materials Science and Engineering Center Roberts Hall, Box: 352120
University of Washington, Seattle, WA 98195, USA
sarikaya@u.washington.edu
http://www.GEMSEC.washington.edu

Abstract

Proteins enable biology to be viable through molecular interactions (such as in antigen-antibody, ligand-receptor, and drug-target) with <nM specificity. Biological interfaces and surfaces, such as between a biopolymer, e.g., protein, and solid, e.g., a biomineral, can be an excellent example for designing interfaces and surfaces for practical technological materials, such as metals, ceramics, semiconductors and composites. These interfaces are mechanically robust and designed at the molecular scale to withstand corrosion, wear and complex chemical and stress conditions, combining soft wand hard materials together in a smooth transition. Using biology as a guide at the molecular dimensions, we biocombinatorially select, bioinformatically enhance and genetically tailor solid binding peptides and utilize them as molecular building blocks in carrying out nano- and molecular materials science and engineering and medicine. Genetically engineered peptides for inorganic materials (GEPI) are used as bionanosynthesizers in biomaterialization, heterofunctional linkers to create thermodynamically stable interfaces between dissimilar materials, and as molecular assemblers for the targeted and directed assembly of nanobiomaterials towards addressable ordered architectures with genetically designed functions. More recently, we discovered that peptides self-assemble forming long-range and short-range ordered (LRO and SRO) hierarchical pseudo-3D structures that undergo classical nucleation, growth and thermally-activated phase transformations forming either kinetically or thermodynamically-controlled molecular thin films on atomically flat solid surfaces. Here, we will give an update of the utility of a variety of GEPIs, which can be catalyzers enabling synthesis, molecular linkers and assemblers, all facililated by molecular recognition at interfaces, in inorganic synthesis for hybrid probe design and bionanosensors; biofunctionalization of implants; biomineral formation for tissue regeneration and restoration; laminated composite design for structural applications; and in peptide-enabled nanoelectronics and nanophotonics to demonstrate the expanding paradigm in nanotechnology and nanomedicine.

Primary funding NSF-MRSEC, NIH-T32, NSF-BioMaterials, and *ARO Programs.*