Department of Chemical and Environmental Engineering

2016—2017 Colloquium Series

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9:30-10:30 AM

WCH 205/206

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Molecular Engineering of Biologically-Inspired Materials

Abstract: New materials that can be programmed to elicit biological responses have enormous potential in therapeutic applications. Our research group uses a biomimetic approach to design such materials. We apply tools of genetic engineering to produce nanostructured, protein-based materials that cannot be fabricated using conventional chemical synthesis. By redesigning architecture and self-assembly behavior at the molecular and nanoscale levels, one can customize these biomaterials to yield novel properties and biological interactions. One example is a self-assembling protein nanoparticle based on pyruvate dehydrogenase. By truncating this complex down to its structural core, we obtain a highly-stable, 25-nm dodecahedron with a hollow cavity. We have demonstrated that this nanoparticle can be designed to accommodate drug molecules, exhibit pH-triggered assembly and drug release, and target cancer cells. Furthermore, treatment with viral-mimetic cancer vaccines designed from these nanoparticles yields a significant increase of survival time in tumor-challenged mice. In another example of biomimetic structure, we have developed a platform to fabricate a new class of polymers that has previously been elusive to create. These biopolymers are based on the extracellular matrix protein collagen, which gives us the potential to control cellular processes by specifically tailoring the underlying matrix material. We show that mechanical properties and non-native cellular responses can be modulated by altering specific chemical and biological sites within the polymers. These studies collectively reveal the tremendous potential of using natural protein scaffolds as a departure point for creating novel classes of biomaterials.

BioSketch: Dr. Szu Wang received a B.S. in Chemical Engineering from the University of Illinois, Urbana-Champaign, and M.S. and Ph.D. degrees in Chemical Engineering at Stanford University, during which she was a Whitaker Foundation Graduate Fellow. After graduation, she held Research Scientist positions at The Liposome Company (Elan Pharmaceuticals) and at TransForm Pharmaceuticals, companies that specialized in drug delivery and formulations. Dr. Wang is now a Professor in the Department of Chemical Engineering and Materials Science at the University of California, Irvine. Her research group designs and investigates biomimetic materials, molecular delivery, and protein self-assembly for applications in therapeutics and tissue engineering. She recently received a Faculty of the Year teaching award from the Engineering Student Council and a Mid-Career Faculty Excellence in Research Award from the School of Engineering at UC Irvine.

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