Carnegie Mellon
Materials Science and Engineering Seminar Series

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"Engineering the Nanoparticle – Biology Interface"

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10:30 AM Seminar in Scaife Hall 125

The synergistic combination of nanotechnology and biology has resulted in numerous of innovative approaches for using biomolecules as machines, new therapies for diseases, and biological and biomolecular sensors. One of the most exciting prospects of nanotechnology is that nanoparticles can act as a "handle" by which one can control nanoscale processes, particularly biological ones. Due to their size, nanoparticles can reach places where such processes are typically inaccessible to external manipulation, such as inside individual cells.

Consequently, nanotechnology has held great promise for enhancing existing biological systems as well as engineering new capabilities in biology. We use laser excitation of gold nanorods to control the release of multiple species independently. Ultrafast laser excitation at the nanorod longitudinal surface plasmon resonance (SPR) heats the nanorod to a high local temperature, inducing melting, which can release biomolecules conjugated to the nanorod. Because the SPR is tunable by changing nanorod aspect ratio, nanorods with different aspect ratios can be excited independently at different wavelengths. We exploit this property for selective and mutually exclusive release of two distinct DNA oligonucleotides, and show that the released DNA is still functional. In addition, we are utilizing nanoparticles to enhance biological reactions. One of the biggest barriers for effective use of nanoparticles in biology is non-specific adsorption, where proteins and DNA non-covalently stick to nanoparticles. Typically, non-specific adsorption is viewed as a major hindrance to nanobiotechnology, but we demonstrate that it is actually ideal for enhancing the efficiency of protein production in an *in vitro* translation mix. By tuning the balance between non-specific adsorption and specific binding, we can optimize enhancement and also enhance translation of a specific gene in a pool.

Dr. Hamad-Schifferli is an Associate Professor in the Departments of Biological Engineering and Mechanical Engineering at MIT. Dr. Hamad-Schifferli received her S.B. in Chemistry from MIT in 1994 and her Ph.D. in Chemistry at the University of California at Berkeley in 2000. She completed postdoctoral work in 2002 at the MIT Media Lab. She joined the faculty at MIT in the Departments of Biological Engineering and Mechanical Engineering in 2002. She has been the recipient of the Office of Naval Research Young Investigator Award (ONR YIP), and the Ruth and Joel Spira Teaching Award for excellence in teaching in Engineering.