Materials Science & Engineering Seminar Series

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presents

From Proteins to Tissues: Multi-Scale Biomodulation by Single Wall Carbon Nanotubes

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ABSTRACT:
Single wall carbon nanotubes (SWCNTs) are increasingly being investigated for biomedical applications including imaging, sensing, ablation and drug delivery. These structures are the same size as many subcellular structures and are chemically inert so they do not interfere with chemical processes of the cell or degrade. We study how SWCNTs interface with proteins to disperse these nanomaterials, which normally aggregate, stably into solution. Also, by changing the protein on the SWCNT surface, we are able to target to different structures within the cell. We use a combination of imaging techniques including Raman spectroscopy and fluorescence lifetime microscopy (FLIM) to visualize SWCNTs inside of different cell types. We utilize unique cellular manipulation together with *in vitro* biophysical techniques to determine changes in cells exposed to SWCNTs.

We have studied the rates and mechanisms of cellular uptake. SWCNTs enter cells at different amounts, typically based on the metabolic potential of cells. Macrophages, specifically, take in large numbers of SWCNTs and bundle them in cellular vacuoles. We also observe that SWCNTs can alter the cytoskeleton inside of cells, which leads to reduced division, altered cell shape and attenuated cell force. When injected into dynamic tissues, including a frog embryo system, we also observe bundling and later expulsion of SWCNTs by the system. Collectively these studies allow us to better know the hazards of nanomaterial research as well as provide the fundamental knowledge necessary to design targeted nanomaterials for subcellular applications.

BIOGRAPHY:

Kris Noel Dahl is an Associate Professor in the Departments of Biomedical Engineering, Chemical Engineering and Materials Science and Engineering at Carnegie Mellon University. Her group is interested in structure and mechanics of materials inside cells including the nucleus and cytoskeleton. By studying these structures, it is possible to provide insight into cell function and adaptation including stem cell differentiation, cancer metastesis and interactions of cells with nanomaterials. Dahl received her BS degree from Carnegie Mellon in 1998, and Ph. D. degree in Chemical Engineering under the supervision of Professor Dennis Discher at University of Pennsylvania in 2004. She performed her postdoctoral fellowship in Cell Biology at Johns Hopkins University before joing Carnegie Mellon in 2007. She is a recipient of a Whiteaker Fellowship and NIH Postdorctoral Fellowship for her training. She received an NSF CAREER award as well as a Young Investigator Award from the World Congress of Biomechanics.

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