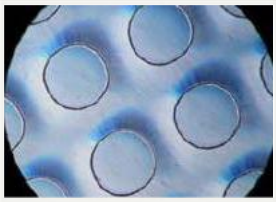
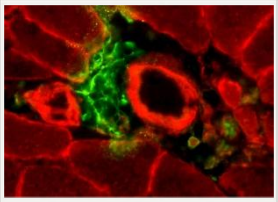
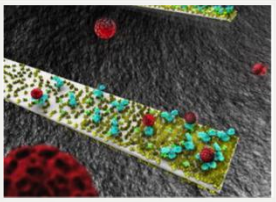
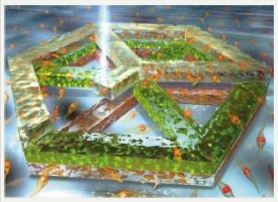
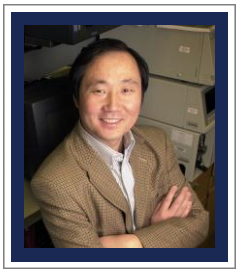
# BioNanotechnology Seminar Series

**Fall 2012**



## Functional DNA Nanotechnology: Precise Spatial and Dynamic Control of Nanomaterials Assembly and its Applications in Sensing, Imaging and Targeted Drug Delivery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http://montypython.scs.uiuc.edu/LuCV/LuCV.php


**Tuesday, December 11, 2012**

**12:00-1:00 p.m. CST (10:00-11:00 a.m. PST)**

**1000 MNTL (SSM 150 at UC Merced)**


### Abstract:

Cell Genetic control of the assembly and disassembly of complex biological structures in response to internal chemical or biological stimuli under ambient conditions have been one of the hallmarks of biology. While proteins play a central role in natural biomaterials, synthetic nanomaterials assembled by nucleic acids are emerging in recent years. DNA has been shown to be highly programmable molecules resulting in a number of 2D and 3D nanostructures. Despite the promise, functionalizing these structures has been challenging. We have developed a novel method of using phosphorothioate DNA as anchors, and a bifunctional linker as a rigid molecular fastener that can connect gold nanoparticles to specific locations on the DNA backbone. Precise distance controls between two nanoparticles or proteins with nanometer resolution have been demonstrated. We are also elucidating DNA "genetic codes" for nanomaterials.

In addition to precise spatial control, dynamic control of the assembly of nanomaterials in response to internal stimuli under ambient conditions is quite important for 3D assembly. To meet this challenge, we took advantage of recent advance in biology, i.e., discovery of functional DNA, a new class of DNAs that can either bind to a target molecule (known as aptamers) or perform catalytic reactions (known as DNAzymes), that are very specific for a wide range of targets, and demonstrated the use of these functional DNA for dynamic control of assembly of gold nanoparticles, iron oxide nanoparticles, quantum dots, and nanotubes, in response to a wide range of chemical and biological stimuli from small metal ions to large biomolecules, including cancer cell markers.[1] Because these nanomaterials possess unique optical, electrical, magnetic and catalytic properties, these systems have been converted into colorimetric, fluorescent, electrochemical sensors, and magnetic resonance imaging agents for detection of a broad range of analytes with high sensitivity and selectivity.[2] The application of functional DNA nanotechnology has also been expanded to include targeted drug delivery.[4]



1. Yi Lu and Juewen Liu, "Smart Nanomaterials Inspired by Biology: Dynamic Assembly of Error-Free Nanomaterials in Response to Multiple Chemical and Biological Stimuli," Acc. *Chem. Res.* 40, 315 - 323 (2007).
2. Hang Xing, Ngo Yin Wong, Yu Xiang, Yi Lu, "DNA aptamer functionalized nanomaterials for intracellular analysis, cancer cell imaging and drug delivery," *Curr. Opin. Chem. Biol.* 16, 429-435 (2012).
3. Zidong Wang, Longhua Tang, Li Huey Tan, Jinghong Li, Yi Lu, "Discovery of the DNA "Genetic Code" for Abiological Gold Nanoparticle Morphologies" *Angew. Chemie Int. Ed.* 51, 9078-9082 (2012).
4. Zehui Cao, Rong Tong, Abhijit Mishra, Weichen Xu, Gerard C L Wong, Jianjun Cheng, Yi Lu
"Reversible Cell-Specific Drug Delivery with Aptamer-Functionalized Liposomes" Angewandte Chemie International Edition 48, 6494-6498 (2009).


**Seminar Presented by:**

Center for Cellular Mechanics
University of Illinois at Urbana-Champaign

IGERT Integrative Graduate Education and Research Traineeship
Cellular and Molecular Mechanics and BioNanotechnology

M-CNTC NCI Alliance for Nanotechnology in Cancer
Midwest Cancer Nanotechnology Training Center

CNST University of Illinois Center for Nanoscale Science and Technology