Biomedical Engineering Seminar Series
Johns Hopkins School of Medicine and the Whiting School of Engineering

Jason J. Benkoski, Ph.D.
Senior Scientist
Johns Hopkins Applied Laboratory

Monday, March 1, 2010, at 1:30
Rome Room, Clark 110, Homewood
Host: Dr. Soumya Acharya

Video-Teleconferenced to the Talbot Library, Traylor 709, School of Medicine

Light lunch will be provided in Clark 110

Artificial Magnetic Cilia Fabricated from the Self-Assembly of Co Nanoparticles

Taking inspiration from eukaryotic cilia, we report a method for growing dense arrays of magnetically actuated microscopic filaments. Fabricated from the bottom-up assembly of polymer-coated cobalt nanoparticles, each segmented filament measures approximately 5 – 15 um in length and 23.5 nm in diameter, which was commensurate with the width of a single nanoparticle. A custom microscope stage actuates the filaments through orthogonal permanent and alternating magnetic fields. We implemented design of experiments (DOE) to efficiently screen the effects of cobalt nanoparticle concentration, crosslinker concentration, and surface chemistry. The results indicated that the formation of dense, cilia-mimetic arrays could be explained by physical, non-covalent interactions (i.e. dipolar associations forces) rather than chemistry. We also report the assembly of structures resembling bacteria that are formed from the assembly of the Co nanoparticle filaments with 250 nm magnetite colloids. Also actuated by our custom magnetic stage, the "head" plus "tail" assembly is among the smallest structures capable of swimming. Boasting the flexibility of biological cilia, we envision applications for this technology that include: micropumps, micro-flow sensors, microphones with hardware-based voice detection, surfaces with enhanced thermal transfer, switchable, tunable filters, and microscopic locomotion.

Jason J. Benkoski*, Ryan M. Deacon, H. Bruce Land, Lance M. Baird, Jennifer L. Breidenich, Rengaswamy Srinivasan, Guy V. Clatterbaugh

Milton S. Eisenhower Research Center, The Johns Hopkins University Applied Physics Laboratory, Laurel MD 20723

Pei Yuin Keng, Jeffrey Pyun*

Department of Chemistry, University of Arizona, Tucson, AZ 85721

http://www.hopkinsmedicine.org/ibbs/news/events.html
http://www.hopkinsmedicine.org/scical
http://www.bme.jhu.edu
For more information call 410-955-3132