

# Seminar Series

Sponsored by

School of Materials Science and Engineering

Thursday, April 2, 2009

5:00 PM – Room 200 Olin Hall

## Shaping Laser Interactions: Direct-Write Processing From Solar Cells to Stem Cells and Beyond

Craig B. Arnold

Department of Mechanical and Aerospace Engineering  
Princeton University

### **Abstract:**

The ability to locally modify materials through laser based direct-write (LDW) techniques enables the formation of structures and material properties that cannot be produced through alternative means. In this presentation, we examine the fundamentals of laser-matter interactions in the context of energy storage and biological applications, with particular emphasis on the material modifications that are induced during LDW deposition. Results show that these methods enable us to independently control the electronic and protonic transport in energy storage systems leading to improved high rate performance. However, by developing methods to shape the mechanical and thermal interactions we gain additional control over the local material properties. In particular, the use of mechanically deformable absorbing layers and spatial shaping of Gaussian beams through newly developed high speed adaptive optical elements enables reliable deposit of delicate materials such as living mammalian embryonic stem cells for tissue engineering applications or organic semiconducting molecules for photovoltaic applications. Time permitting, we will build upon these approaches, and discuss extensions to LDW processing that enable processing below the diffraction limit using a combination of Bessel beam generation, optical trapping and near-field optical effects.

### **Bio:**

*Craig B. Arnold is an assistant professor at Princeton University in the department of mechanical and aerospace engineering and the Princeton Institute for Science and Technology of Materials. His research area involves laser processing and transport in materials with particular interest in energy storage, photonic materials, nanoscale patterning, and laser based direct write technologies. He earned his PhD. in condensed-matter physics from Harvard University and was an NRC post-doctoral fellow at the Naval Research Laboratory prior to joining the faculty at Princeton. He has published over 60 papers on laser materials processing in professional journals, book chapters and proceedings and serves on the organizing committee of a number of laser materials conferences including SPIE photonics west, LPM, ICALEO, CLEO, and PICALO. In addition, he has a number of awards recognizing his work including the ONR young investigator award and the NSF Career award.*