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Mechanical Engineering Lecture in Energy

Advanced Energy Conversion and Storage Devices using Nanostructured Materials

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on Friday, February 6th at 4:00pm in 3-270

One of the key challenges facing the widespread use and commercialization of promising energy devices (i.e. fuel cells, batteries, organic solar cells etc.) is the high cost of the electrocatalytic and electrolyte materials and inefficiencies in their assembly and utilization. In this talk, I will present three examples of how we are designing nanomaterials such as graphene-based carbons and bulk metallic glass (BMG) alloys that can be incorporated into multifunctional composites for high performance nanostructured-enabled energy devices.

1) *Spin Spray Layer-by-Layer (SSLBL) Assembly*. We have developed a fully automated SSLBL system with deposition at sub-second cycle times allowing nano-level control over film growth and efficient formation of a conducting network not available with other solution based deposition methods for lithium ion battery electrodes. This platform technology can be used to create many other systems (i.e. specialty coatings, drug delivery, etc.)

2) *Electrocatalysts.* We will describe a new class of materials, $Pt_{58}Cu_{15}Ni_5P_{22}$ bulk metallic glass that can circumvent Pt-based anode poisoning and agglomeration/dissolution typically associated with supported catalysts during long-term operation in fuel cells. These amorphous metal alloys can serve as an interesting platform for next-generation catalysts and devices such as the first all bulk metallic glass micro fuel cell.

3) *Network Electrodes (See Fig.).* Here we describe a technique for developing freestanding multifunctional SWNT composite thin films that provides a fundamental engineering basis to bridge the gap between their nano and macroscale properties for solar cell transparent conductive electrodes. We will also describe recent efforts in using these films as active layers in hybrid SWNT/Si solar cell device as well as the use of Förster resonance energy transfer for high efficiency small molecule and polymer solar cells.

Refreshments will be served before the seminar.
Please contact Tony Pulsone at pulsone@mit.edu with any questions.

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