

## *Real time observations of the nucleation and growth of nanowires and nanotubes*

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### **ABSTRACT**

Crucial to the application of nanostructured materials is control over their nucleation and growth, as these aspects determine their structure and thus properties. We will review our work concerning these issues in both semiconductor nanowires and carbon nanotubes. These studies exploit a combination of environmental and ultra-high vacuum TEM approaches to observe these processes in real time and at high resolutions.

Interestingly, nanowire and nanotube growth share many similarities. In each case small metal nanoparticles are used to catalyze the decomposition of relatively simple source gas. This decomposition leads to incorporation of the growth element (Si, Ge, C, ...) into the particle until supersaturation is reached and the new nanostructure nucleates and grows. We will present measurements of the nucleation and growth process in Si nanowires, quantifying the process as it proceeds from the initial solid Au nanoparticle, through the creation of the AuSi eutectic liquid and finally towards Si nanowire nucleation and growth. The observations will demonstrate the reproducibility of the process, and allow determination of the rate limiting steps for nanowire growth. In the case of carbon nanotube growth, we will demonstrate that both Ostwald ripening and atomistic diffusion of the Fe catalytic nanoparticles lead to growth termination and we will present early results that suggest a pathway towards the creation of an 'immortal' catalyst to support continuous nanotube growth. Recent observations suggesting a route towards chirality control will also be outlined. Specific parallels and differences between our nanowire and nanotube observations will be made.

### **BIOGRAPHY**

Eric Stach leads the Electron Microscopy Group in the Center for Functional Nanomaterials (CFN) at Brookhaven National Laboratory. He received his Ph.D. in Materials Science and Engineering from the University of Virginia. He has held positions as Staff Scientist and Principal Investigator at the National Center for Electron Microscopy at the Lawrence Berkeley National Laboratory and as Associate then Full Professor at Purdue University, where he retains an Adjunct appointment. His research interests focus on the development and application of electron microscopy techniques to solve materials problems in nanostructure growth, catalysis, thin film growth and materials deformation.



### **EVENT DETAILS**

**DATE:**

Wednesday Oct. 24, 2012

**TIME:**

11:00 AM

**LOCATION:**

Babbio Center, Room 122  
Stevens Institute of Technology

**ATTENDANCE:**

This event is open to Stevens' Faculty, Students, Staff, and Invited Guests

**Co-Sponsored by the  
CEMS Department**