

## Materials Science Workshop Report 2006

The 2006 Materials Science Workshop for high school science teachers sponsored by CCMR was held in Baker Labs, Cornell University on October 21<sup>th</sup>, 2006. Fifteen chemistry and physics teachers from around New York State attended the full day professional development workshop. Eleven CCMR faculty members and nine graduate students from Chemistry, Engineering, Physics and Textiles & Apparel helped to run a variety of demonstrations throughout the day. One teacher wrote of the value of the workshop to her: "I had a great day. I learned a lot. I have many new ideas to take back to my classroom."

As in the past, the workshop was organized into two distinct sessions: the morning was devoted to polymeric materials and the afternoon focused on non-polymers. Teachers first attended an introductory lecture on polymers given by Professor Frank DiSalvo, Chemistry & Chemical Biology, where they learned about the characteristics of various polymers, the techniques used to examine such materials and a preview of the demonstrations they would see in the lab. The teachers were unanimous in their praise for the morning lecture, saying that it was "helpful in preparing for the demos", and "very valuable to cover theory."

Following the lecture, the teachers walked to the teaching labs in Baker where they spent time examining and participating in ten demonstrations, interacting with the professors and their graduate student helpers. The teachers were encouraged to move between the demonstrations in small groups so that they could interact individually with the presenters. In this way the teachers were able to tailor the experience to their own needs and move through the presentations and activities at their own pace.

Professor Itai Cohen, Physics, presented demonstrations on polymeric materials' properties including: the Rubber Band/Triple Beam Balance Demo and the Overhead Polymer Demos.

Professor Anil Netravali, Fiber Science & Apparel Design, and graduate student Xiaosong Huang presented demonstrations on breathable fabrics (Gortex) and Super Strength Surgical Gloves.

Professor Stephen Lee, Chemistry & Chemical Biology, used solid state crystal model kits to talk with teachers about crystal structure in a variety of materials.

Graduate students Kate Peretti, Jason Geno and Sean Ramirez, Chemistry & Chemical Biology, demonstrated electrospinning of polymers to make non-woven fiber materials. They also presented demonstrations on Elastic liquids and performed the Nylon Rope Trick.

Professor of Chemistry & Chemical Biology, Geoff Coates presented Shrinky Dinks to demonstrate glass transition point in an amorphous polymer; this station is a perennial favorite amongst the teachers.

Physics graduate student, Luke Donev, presented two stations, Heat Gun Demos and Happy/Sad Balls. At these stations Luke demonstrated the variation in physical properties between two similar appearing polymers.

After a lunch break the teachers reassembled for the afternoon session on non-polymeric materials. The afternoon was passed in much the same way as the morning, starting off with an introductory lecture by Professor of Materials Science & Engineering, Bruce van Dover and former CCMR Director, Frank DiSalvo. The teachers then returned enthusiastically to the labs and started their rounds on a group of eight new demos.

The afternoon session included a diverse range of materials as it encompassed all types of non-polymers. Professor DiSalvo presented a station on work-hardening using annealed copper rods. Many teachers spent a long time with him working out the differences between intrinsic and extrinsic properties of materials and talking about how defects affect a material's behavior.

Professor Van Dover, Materials Science & Engineering, presented a station on superconductors.

Graduate student, Steve Hickman, Chemistry & Chemical Biology, presented an activity for high school chemistry, using Light Emitting Diodes (LEDs).

Ian Clark, a graduate student in Chemistry & Chemical Biology, talked with teachers about Memory Metal (Nitinol).

Assisted by graduate student Stephane Badaire, Professor Abe Stroock, Chemical Engineering, presented a station on Brownian motion which teachers found very useful.

Nano-wires, was led by Professor Garnet Chan, Chemistry & Chemical Biology. Teachers constructed models of nano-tubes and learned how folding of the graphite sheets affects the tubes' properties.

Copper to "Silver" and "Gold", always a popular station on plating zinc and tin onto copper pennies to create alloys was presented by Applied & Engineering Physics graduate student Mark Prochaska.

Professor Brian Crane, Chemistry & Chemical Biology, presented a station on diffraction using a wire grating and lasers to explain how diffraction of light is used to measure small distances.

Professor Peng Chen, of Chemistry & Chemical Biology, created a new activity for this year's workshop called "Single vs. Mingle" which is designed to convey the concept of single-molecule measurements versus ensemble-averaged measurements.

The teachers went home with a kit of materials with which they could replicate many of the demonstrations in their own classrooms; they were also given Teaching General Chemistry: A Materials Science Companion, by Ellis et al which explains how to set up the demos and gives a detailed science background on each.

**Personnel Involved (Cornell University Department of Chemistry and Chemical Biology, Department of Physics, Department of Material Science and Engineering, Department of Textiles and Apparel, School of Chemical Engineering and Cornell Center for Materials Research)**

Professor Francis DiSalvo (Chemistry and Chemical Biology)  
Professor Anil Netravali (Textiles and Apparel)  
Professor Itai Cohen (Physics)  
Professor Bruce VanDover (Materials Science and Engineering)  
Professor Kit Umbach (Materials Science and Engineering)  
Professor Brian Crane (Chemistry and Chemical Biology)  
Professor Garnet Chan (Chemistry and Chemical Biology)  
Professor Stephen Lee (Chemistry and Chemical Biology)  
Professor Geoffrey Coates (Chemistry and Chemical Biology)  
Professor Abe Stroock (Chemical and Biomolecular Engineering)  
Professor Peng Chen (Chemistry and Chemical Biology)  
Mr. Sean Ramirez (Graduate Student, Chemistry and Chemical Biology)  
Mr. Luke Donev (Physics)  
Mr. Steve Hickman (Chemistry and Chemical Biology)  
Mr. Mark Prochaska (Applied and Engineering Physics)  
Mr. Ian Clark (Chemistry and Chemical Biology)  
Mr. Jason Geno (Graduate Student, Chemistry and Chemical Biology)  
Ms. Kate Peretti (Graduate Student, Chemistry and Chemical Biology)  
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