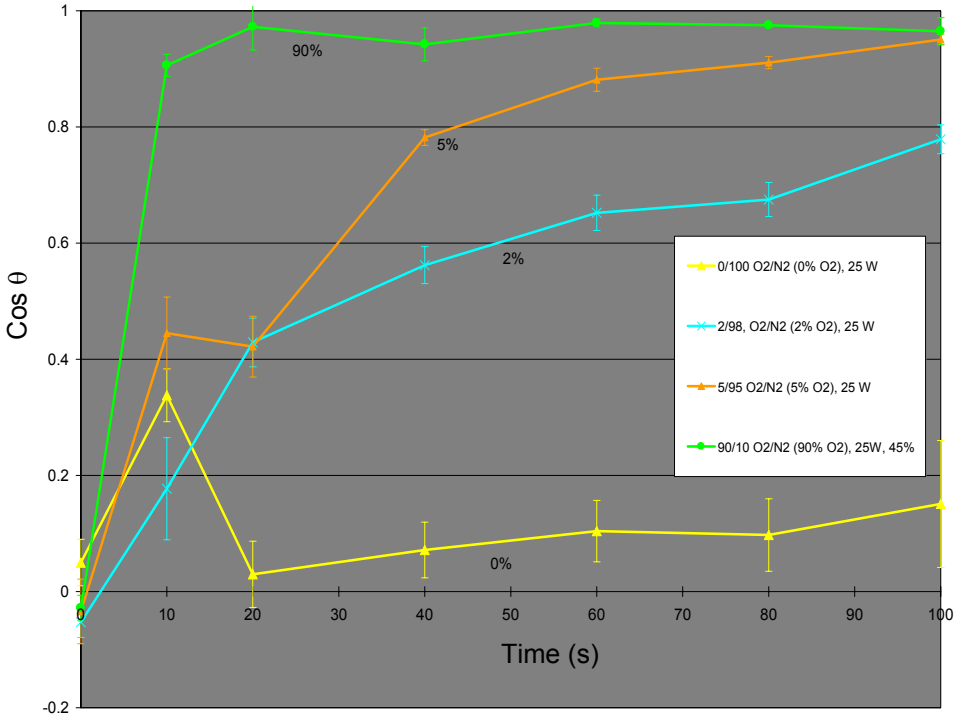
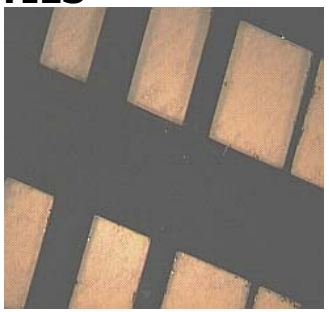
Physico-chemical Characterization and Processing of Nanocomposite Polymers for Microfluidic Applications

Brian H. Augustine, Wm. Christopher Hughes, James Madison University **DMR-0405345**

RECENT ACTIVITIES



- Surface hydrophobicity can be controlled via remote plasma treatment of spun-cast thin films of polymethylmethacrylate-45% polyhedral oligomeric silsesquioxane (PMMA-POSS).
- O_2/N_2 plasma surface exposure converted a surface from highly hydrophobic as measured by contact angle measurements, to highly hydrophilic after 2 minutes @ 25 W forward power.
- Varying the O_2/N_2 ratio enables us to control the hydrophilicity of the surface. This is potentially useful to control the surface chemistry inside of microfluidic devices.



Etched Si wafer

H_2O dewetting off plasma patterned PMMA-POSS surface

- Plasma exposure masks have been fabricated by through-wafer Si etching. Remote plasma exposure of a PMMA-POSS surface resulted in an alternating hydrophobic / hydrophilic surface.
- Samples have been mailed out for XPS and TOF-SIMS analysis to College of William & Mary.

Other activities:

- Modification of existing turbomolecular remote plasma system with an external load-lock chamber.
- Development of a novel polymer patterning technology called micromolding using polymerization in capillaries (μ-PIC) (invention disclosure being filed through the UVA Patent Foundation.)
- Development of a simple flow measurement capability in microfluidic devices.

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EDUCATIONAL ACTIVITIES

- Two undergraduate students were directly funded through this project from the departments of Physics and Integrated Science at James Madison University. Senior, Thomas DiCarlo (ISAT), worked on the microfabrication and surface plasma patterning and sophomore, Alex Beck (Physics), worked on modification of the existing vacuum system and developing a method to measure the flow rate in microfluidics.
- In addition to RUI funding, two undergraduate students funded through the NSF-REU sites in chemistry (Rozine Lindamood) and materials science (Jessica Maidment-Randolf Macon Womens College) also worked directly on this project on microfabrication and the remote plasma surface treatment.
- One JMU student (Toni Bonhivert), worked on electroosmotic flow measurements of plastic microfluidic devices fabricated by students working at JMU. She was funded through the NSF-REU site at the University of Virginia in the Department of Chemistry working in the laboratory of Dr. James Landers.
- A total of eight undergraduates worked in our labs this summer. At present, five of the students are planning on graduate school in SMET disciplines.

JMU undergraduate, Stephen Delfaus (left), teaching fellow JMU undergraduate students Tynesha McClain (sitting) and Matt Hrabak (standing) how to use the atomic force microscope to analyze polymeric thin films.