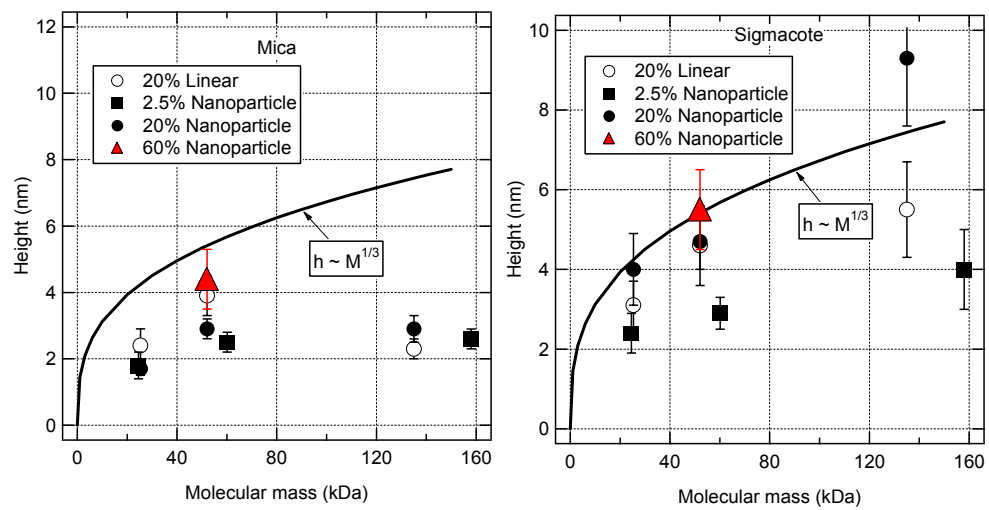
Molecular Architecture Effects on Polymer Conformation at Surfaces

Michael E. Mackay, Michigan State University, DMR-0210247
with C. Hawker (IBM)

The conformation of polymeric nanoparticles on solid substrates is important in biology and information technologies. We have found that introduction of some rigidity into the nanoparticle is necessary for them to follow a $M^{1/3}$ relation expected for a constant density particle. Introduction of rigidity was accomplished through crosslinking individual polymer chains that constitute the nanoparticles. Further results show the substrate energy plays a key role in affecting their conformation. A low energy substrate (non-wetting) and a large degree of crosslinking (20-60%) is necessary to produce robust sphere-like particles on the surface.



Polymeric nanoparticles and linear polymers both collapse on a high energy substrate (mica, left graph). They do not follow the $M^{1/3}$ scaling a rigid sphere should follow. Placing the nanoparticles on a low energy substrate (sigmacote, right graph) reveals that 20% and 60% crosslinking within the nanoparticle allows their height to approach the expected relation.

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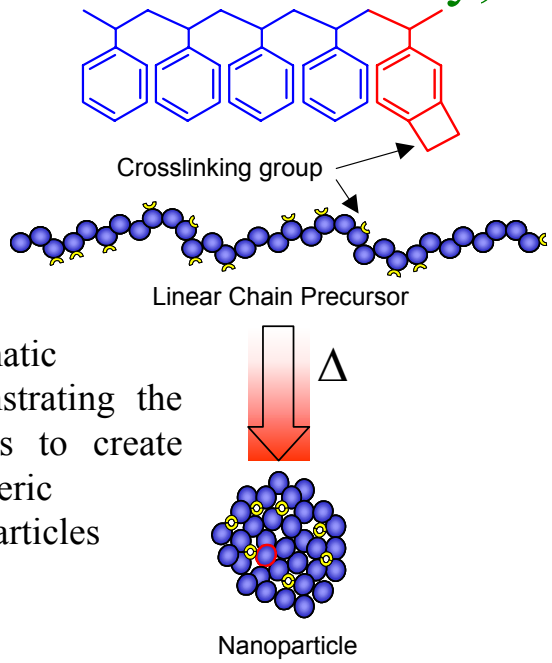
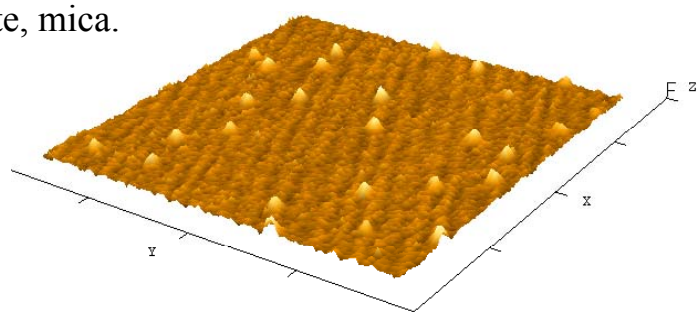


Schematic demonstrating the process to create polymeric nanoparticles

AFM image of 52.0 kDa - 20% crosslinked, polystyrene nanoparticles on a high energy substrate, mica.



Education and Outreach:

During Summer 2004, Prof. Mackay, together with Prof. Greg Baker (Chemistry Department, Michigan State University), hosted an REU student, Ms. Kim Pham (University of Central Oklahoma), and Prof. Mackay hosted Mr. Ian Wilhite, a high school student from the Lansing area. Both these students were exposed to the research conducted through the NIRT grant.

As a result of this grant, Prof. Mackay taught a graduate course entitled, "An introduction to nanotechnology," during Fall semester 2003. Fourteen graduate students in the chemistry, mechanical engineering and chemical engineering and materials science departments attended the course. Due to the success of this course Prof. Mackay will teach "Nanoscale characterization" during Spring semester 2005.