

NC State University
Chemical and Biomolecular Engineering
Graduate Student Association
Seminar Series

**Modification of Polymer/Polymer Interfaces
Using Microgel Particles and Block Copolymers**

Omer Gozen

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5:30–6:15 p.m.

2015 EB1

We investigate the modification of the polystyrene (PS)/poly(methyl methacrylate) (PMMA) interface due to: (i) interfacial partitioning of PS-*b*-PMMA and (ii) the thermal response of microgel particles (μ GPs) composed of a cross-linked divinylbenzene core and poly(methyl methacrylate) (PMMA) arms. Incorporation of a block copolymer into a PS/PMMA polymer thin film system significantly increases the stability of the PS film by either slowing down or completely eliminating dewetting of the top PS layer resting on an underlying PMMA film. It has been shown that the PS film dewetting rate depends on: (i) the concentration of block copolymer, (ii) the PS film thickness. The stability of the PS film can be enhanced by either increasing the block copolymer concentration at the PS/PMMA interface or by increasing the PS film thickness. We also explore thermal behavior of microgel particles (μ GPs) composed of a cross-linked divinylbenzene core and poly(methyl methacrylate) (PMMA) arms, which can be imagined as permanently cross-linked block copolymer micelles. When in contact with a free surface, the particles migrate to the film surface due to autophobicity between the densely packed short PMMA arms on the microgel particles and the long PMMA chains in the matrix. The microgels cannot, however, break through the surface because of the high surface energy of PMMA. When a polystyrene (PS) capping layer is placed on top of a PMMA/ μ GP film, the μ GPs segregate to and thus roughen the PMMA/PS interface, as evidenced by AFM analysis. We attribute this behavior to a change in surface vs. interfacial energetics. Specifically, while the high surface energy of the native PMMA film keeps the particles inside the bulk PMMA, placing a thin PS layer on top of the PMMA/ μ GP film decreases the PMMA/PS interfacial tension by about an order of magnitude, which consequently permits segregation of the μ GPs to the PMMA/PS interface. We demonstrate the possibility of patterning the segregated μ GPs by contacting a corrugated poly(dimethylsiloxane) (PDMS) layer to PMMA/ μ GP films. Regions of the PMMA/ μ GP film touching the PDMS layer exhibit μ GP segregation, while non-contacted regions appear featureless. This nanoscale process is reversible and can be captured at intermediate degrees of completion. Moreover, this behavior is expected to be fundamentally general and can be exploited as an alternative means by which to reversibly pattern or functionalize polymer surfaces for applications requiring responsive nanolithography.

Refreshments will be served 6:15–6:30 p.m. in the faculty lounge.