Characterization of Interfaces and Interphases in Polymeric Materials Systems

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The purpose of this research is to investigate the role of interfaces and interphases on the properties and performance (durability and appearance) of polymeric systems and nanocomposites. This research area includes (1) development of characterization techniques to measure mechanical, chemical, physical, and optical properties of microscopic volume elements with nanoscale spatial resolution using atomic force microscopy (AFM), nanoindentation, scattering and reflection (light and neutron) techniques; (2) metrology development of chemical nanoprobe microscopy evolving AFM technology such as chemical modified conventional AFM probes and carbon nanotube probes. These techniques will be used in combination with other surface characterization techniques, such as contact angle, FTIR, TEM, SIMS, XPS, confocal Raman spectroscopy, and NSOM with vibration spectroscopy detection through collaborations with MSEL, PL, and CSTL Laboratories. Examples of surfaces and interfaces that will be investigated include (1) polymeric coatings (pigmented and unpigmented), (2) amorphous and semicrystalline polymers (homopolymers and rubber-modified), (3) two-component polymer blends applied to inorganic and plastic substrates, (4) chemically-modified carbon nanotubes, and (5) carbon nanotube/polymer composites. Experimental data obtained regarding interfaces and interphases development will be used in numerical models to understand and predict interface/interphase development from fundamental thermodynamic and kinetics principles.