

Modes and Mechanisms of Polymers and Coatings Degradation

T Nguyen and J W Martin

The purpose of this research is to identify and understand the degradation modes and degradation mechanisms of polymers and coatings subjected to various conditions of UV light, relative humidity, temperature, and electrolytes, or a combination of these environmental factors. The information obtained from this research is needed to develop more accurate conceptual and mathematical models for predicting the performance and service lives of plastics, coatings, and sealants used in building and construction. Information on the degradation mode, e.g., uniform thickness loss vs localized pitting or interfacial failure vs cohesive failure, is derived from thorough and careful characterization investigation of the surface, interface/interphase, and bulk morphology and microstructure of the used polymeric materials at the nanoscale or molecular level before and after exposure to the environments. Techniques used for the degradation mode work include AFM, SEM, FTIR, and ellipsometry. Data on degradation mechanism is provided by methodical and systematic studies of the molecular chemical structures of the used polymers and their model compounds before and after environmental exposures. Analytical techniques, such as FTIR (transmission and reflection), UV-visible spectroscopy, GC/MS, XPS, and NSOM with vibrational spectroscopy detection through collaborations with NIST Chemical Science and Technology Laboratory (CSTL) are employed for degradation mechanism study.