

## DEGRADATION AND NANOPARTICLE RELEASE OF POLYMER NANOCOMPOSITES EXPOSED TO UV

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### Abstract

Nanoparticles are increasingly used for enhancing multiple properties of polymers in many industries including construction, automobile, and aerospace. However, recent research suggests that nanoparticles might have negative effects on the environments and health safety. Since organic polymers are susceptible to photodegradation by solar UV radiation, nanoparticles imbedded in a polymer nanocomposite will eventually be released into the environments during their life cycles. Such a release of nanoparticles might have a great effect to the environments and present a roadblock on their potential uses. This study investigates the degradation and nanoparticle release of polymer composites containing several types of nanoparticles including carbon nanotubes (CNTs), functionalized CNTs, and nanosilica which are being used in coatings. The morphology and chemical composition of the released nanoparticles are also studied. Specially-designed cells containing nanocomposite specimens are exposed to a NIST-developed UV environmental chamber in which the UV wavelength, UV intensity, relative humidity, and temperature are well controlled. Exposed samples are removed for measurements of polymer chemical degradation, mass loss, and nanoparticle release using a variety of analytical techniques. The amounts and rates of nanoparticle release are determined by thermogravimetry, which readily separates nanoparticle loss from polymer degradation. The results show that polymer nanocomposites containing 1 % multi-walled CNTs exposed to UV radiation >290 nm chemically degrade at a much slower rate than those containing other types of nanoparticles. The rates and amounts of nanoparticles released from the nanocomposites follow closely with the rates of photodegradation and mass losses of

the exposed samples. Chemical composition and morphology of the released nanoparticles during UV exposure are being collected and will be discussed.