A simple methodology for observing mechanical properties of nanocomposites
Part 1: interfacial properties in an Epoxy Clay Nanocomposites

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Abstract

Research by the Pinnavaia Group and Mülhaupt *et al.* on elastomeric polyurethane and elastomeric epoxy clay hybrid nanocomposites have shown that the tensile strength, tensile modulus and strain-to-failure of these nanocomposites are increased relative to the neat matrices. These results contrast the behavior observed in fibrous composites and fulfill the promise, as envisioned by early researchers, of using nanotechnology to achieve significant increases in materials performance. However, similar results on glassy epoxies, which are often used in structural composites, by Pinnavaia and Kornmann, Mülhaupt, *et al*. indicate that, like conventional composites, modulus and strength increases in the nanocomposite are achieved at the expense of its strain-to-failure. In addition, research on thermoplastic polyolefin (TPO) nanocomposites also shows a significant reduction in strain-to-failure with nanomaterial incorporation. TPO nanocomposites have been targeted for use in semi-structural automotive applications.

The performances of these nanocomposites are achieved without the establishment of significant adhesive forces between the nanomaterial and the matrix. This suggests that the potential detrimental effects of substrate-matrix debonding that characterize the behavior of conventional composites may be offset in some cases by the morphology of the nanocomposite and/or the intrinsic toughness/ductility of the matrix and interphase region. To understand and quantify the effect of these factors on nanocomposite strain-to-failure, a methodology was developed that detects the onset of clay-matrix debonding in transparent nanocomposites.