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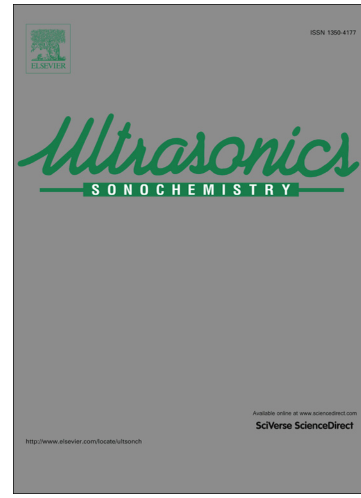

Impact of ultrasonic assisted triangular lattice like arranged dispersion of nanoparticles on physical and mechanical properties of epoxy-TiO_2 nanocomposites

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Impact of ultrasonic assisted triangular lattice like arranged dispersion of nanoparticles on physical and mechanical properties of epoxy-TiO_2 nanocomposites

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ABSTRACT. Emerging ex-situ technique, ultrasonic dual mixing (UDM) offers unique and hitherto unapproachable opportunities to alter the physical and mechanical properties of polymer nanocomposites. In this study, triangular lattice-like arranged dispersion of TiO_2 nanoparticles (average size ~ 48 nm) in the epoxy polymer has been attained via concurrent use of a probe ultra-sonicator and 4 blades pitched impeller which collectively named as UDM technique. The UDM processing of neat epoxy reveals the generation of triangular lattice-like arranged nanocavities with nanoscale inter-cavity spacing. The UDM processing of epoxy-TiO_2 nanocomposites reveals two unique features such as partial and complete entrapping of the nanoparticles by the nanocavities leading the arranged dispersion of particles in the epoxy matrix. Pristine TiO_2 nanoparticles were dispersed in the epoxy polymer at loading fractions of up to 20% by weight. The results display that the arranged dispersion of nanoparticles is very effective at enhancing the glass transition temperature (T_g) and tensile properties of the epoxy at loading fractions of 10 wt.%. We quantify a direct relationship among three important parameters such as nanoparticle content, cluster size, and inter-particle spacing. Our results offer a novel understanding of these parameters on the T_g and tensile properties of the epoxy nanocomposites. The tensile fracture surfaces revealed several toughening mechanisms such as particle pull-out, plastic void growth, crack deflection, crack bridging and plastic deformation. We show that a strong nanoparticle-matrix interface led to the enhanced mechanical properties due to leading toughening mechanisms such as crack deflection, plastic deformation and particle

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