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Increasing Toughness of Oriented Polyvinyl Alcohol (PVA)/Fe3O4 Nanocomposite

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Abstract : Polymer nanocomposites are a new class of materials for fabricating future multifunctional and lightweight structures. To obtain good mechanical, thermal and electrical properties, it is essential to achieve uniform dispersion of nanoparticles in polymer matrix. Alignment of nanoparticles in matrix can enhance mechanical, thermal, electrical and barrier properties of nanocomposites in oriented direction. Fe3O4 nanoparticles have generated huge activity in many areas of science and engineering due to its magnetic properties. Magnetic nanoparticles have been investigated for a wide range of applications in sensors, magnetic energy storage, environmental remediation, heterogeneous catalysts and drug delivery. The magnetic response from the Fe3O4 nanoparticles can facilitate with the alignment of nanofillers in a polymer matrix under magnetic field, aiming at fabricating composites with directional properties and functions. Here we report oriented nanocomposites based on Fe3O4 nanoparticles and poly (vinyl alcohol) (PVA), which prepared via a facile aqueous solution by applying a low external magnetic field (750 G). A significant enhancement of mechanical properties, and especially toughness of nanofilms, of oriented PVA/ Fe3O4 nanocomposites is obtained at low nanoparticles loading. Orientation of nanoparticles can align polymer chains and enhance mechanical properties. For example, orientation of 0.1 wt. % Fe3O4 nanoparticles increase 31% toughness and 23% modulus of oriented nanocomposite in compare of pure films, which indicate good dispersion of nanoparticles and efficient load transfer between nanoparticles and matrix.

Keywords : magnetic nanoparticles, nanocomposites, toughness, orientation
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