Magneto-responsive Smart Polymer Composites and Their Magnetorheology

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Abstract

Magnetic stimuli-responsive magnetorheological (MR) materials have been regarded as one of the most important intelligent and smart materials for their various electromechanical device applications with a large and tunable increase in viscoelastic characteristics under an external magnetic field [1, 2]. When a magnetic field is imposed, their rheological properties vary by showing a characteristic fibrillation with strings of the particles oriented along the magnetic field direction. Soft-magnetic carbonyl iron (CI) particles are known to be superior candidate of MR fluids and MR elastomers due to their high saturation magnetization and appropriate particle size, however, they have severe sedimentation problem due to the large mismatch of the particle density to the carrier oil in the case of MR fluids. Therefore, our efforts on improving MR characteristics of the magnetic particles along with their rheological analysis for both MR fluids and MR elastomers have been focused. Coating the surface of CI particles produces favourable core-shell structure along with apparently decreased density for synthesized composite particles with PMMA, PS, PVB, and PANI via either solvent casting or conventional in-situ dispersion polymerization [3-5]. Double wrapping process with polymeric shell (PMMA, PANI, and PS) and CNT layers were also studied along with new technology of foaming [6, 7]. Magnetite has also attracted much attention due to the relative low density compared with CI particles. MR elastomers with both pristine CI and modified CI particles in various elastomers have been examined along with their characterization and potential engineering applications [8, 9]. As a new technology of fabricating smart polymer composites, Pickering emulsion polymerization to synthesize magnetic composite particles will be also discussed [10-12].

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