TB05

Magnetic Composites of Conducting Polyaniline/nano-sized Magnetite and Their Magnetorheology

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Magnetorheological (MR) fluids, composed of colloidal particles dispersed in a carrier liquid, are regarded as a kind of fascinating smart materials with controllable properties by an external magnetic field. They show dramatic, rapid and reversible changes of rheological properties such as yield stress and an enhanced viscosity caused by transformation within milliseconds from solid-like to liquid-like state. Various theoretical and experimental approaches have been adopted into exploring new MR materials. Magnetite (Fe_3O_4) has gained much attention due to the interesting and various applications for magnetic storage media, printing inks, ferrofluids and magnetic guided drug delivery and so on. Recently, conducting polyaniline (PANI) has become more and more crucial for its novel properties including chemical stability, special doping mechanism and good processibility. Thereby, in this work, we synthesized conducting PANI/ nano-sized Fe_3O_4 composites which could be adopted as a disperse phase of the MR fluids.

The conducting PANI was prepared by in-situ oxidative polymerization, following a dedoping process of PANI using NaOH and HCl solution. Composites containing nano-sized Fe_3O_4 were synthesized via a chemical method. The Fe_3O_4 was synthesized in presence of solution of the emeraldine base form of PANI dissolved in N-methyl-2-pyrrolidone (NMP) at room temperature. The pH value of the mixed solution was adjusted by adding NH_4OH and the pH value was about 11. The fabricated PANI/Fe_3O_4 composite particles were dispersed in silicone oil to prepare of MR fluids.

Microstructure and composition of the obtained PANI/Fe_3O_4 composites were characterized by scanning electron microscopy (SEM), transmission electron microscopy (TEM), and Fourier Transform infrared spectroscopy (FT-IR). X-ray diffraction (XRD) analysis was also used to identify the chemical compositions in whether the Fe_3O_4 was successfully synthesized Fe_3O_4 and what the crystallinity of the composite was. Electrical conductivity measured by a ring-probe method using a resistmeter was about 10^{-10} S/cm. In addition, magnetic properties of the composites were characterized by vibration sample magnetometer (VSM). Finally, the MR fluids of PANI/Fe_3O_4 composites were investigated to show a typical MR performance by using a rotational rheometer equipped with a magnetic field generator.

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TB06

Novel carbonyl Iron/polystyrene Composites Prepared via Solvent Casting and Their Magnetorheology

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Magnetorheological (MR) fluids, colloidal suspensions of micron sized magnetic particles in a nonmagnetic medium, are regarded as smart materials with controllable properties under an external magnetic field have been well applied in designing various dampers or torque transducers. However, MR fluids have many shortcomings, such as sedimentation and abrasion, because most of the magnetic particles applied for the MR fluids possess high density and rigid structure. To overcome these problems, we synthesized novel magnetic carbonyl iron/polystyrene (CI/PS) composites via solvent casting method.

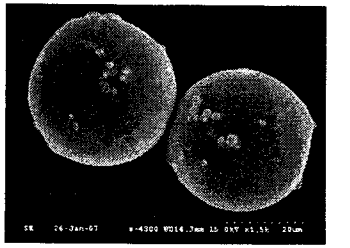

Fig. 1. SEM image of CI/PS particle.

In this study, polystyrene was first dissolved in chloroform, then CI particles were transferred into this solution which was very quickly added into deionized water containing stabilizer, poly(vinyl alcohol) and emulsifier (sodium dodecyl sulphate, SDS) in continuously agitated deionized water. The obtained composite particles were washed with deionized water to remove physically adsorbed reactant at the surface of the composites.

Morphology and molecular structure of the fabricated particles were examined by scanning electron microscopy (SEM) images, transmission electron microscopy (TEM) images, and FT-IR spectra respectively. The weight percent of the CI particles embedded in the PS spheres was analyzed by TGA measurement. By using a gas pycnometer, the density of the produced CI/PS particles was investigated to be much lower than that of the pristine CI particles. To prepare MR fluids, the synthesized CI/PS particles were dispersed in Yubase oil. The MR properties (yield stress and flow response) were investigated by a rotational rheometer (MCR 300) with the magneto-rheological device (MCR 180), demonstrating typical MR characteristics.

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