TB07

Polymeric Nanobead Coated Carbonyl Iron Particles and Their Magnetic Property

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Recently, polymer/magnetic composite particles have drawn tremendous attentions due to their various engineering potential applications. A sort of fantastic fluids, magnetorheological (MR) fluidswhich possess unique ability to solidify into pasty consistency in the presence of a magnetic field and re-liquefy in the absence of the external field, have great perspective in designing damper active systems, torque transducer and MR polishing et al. Among those potential MR candidates (magnetite, maghemite, carbonyl ironet al), carbonyl iron (CI) particles have attracted great attention due to the high saturation magnetization as well as the appropriate particle size. However, the instability of CI suspension which was attributed to the big density mismatch between the dispersed CI particles and the medium has affected its predominant role for MR applications. Many additives or coating technology was explored to prevent this unexpected defect. In this work, a novel magnetic carbonyl iron/polystyrene (CI/PS) composite with nano-scaled PS spheres sprinkled on the surface of the CI particles was fabricated. The physical properties as well as the MR behaviours were investigated.

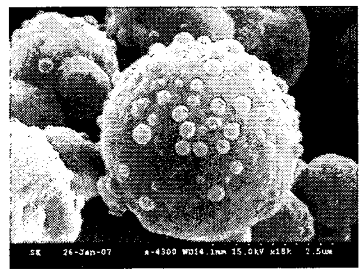

Fig. 1. SEM images of CI/PS particles.

A simple dispersion polymerization was adopted to synthesize PSparticles in a mixture of polyvinylpyrrolidone (PVP)/methanol solution and the pre-treated CI particles by methacrylate acid (MAA) using AIBN as an initiator. When the polymerization was finished completely, a magnet was employed to separate the magnetic CI/PS composites and the residual polymer mixture, then the obtained CI/PS particles was washed by methanol and dried. PS particles which were extracted via a centrifuge from the residual mixture were adopted as reference for the CI/PS composites.

Scanning electron microscope (SEM) and transmission electron microscope (TEM) images confirmed the as-synthesized nano-sized PS particles were spread over the surface of the MAA-treated CI particles but not randomly located in the interspaces of CI particles. FT-IR spectra and vibrating sample magnetometer contributed to analyze the chemical constitution and magnetization performance separately. MR fluids based on the synthesized CI/PS magnetic composites weredetected to indicate typical MR behaviours via a rotational rheometer (Physica MC 300, Stuttgart, Germany) with a magneto-rheological device. Finally, sedimentation ratio was found to be reduced for this CI/PS suspension compared with that of the pure CI system.

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TB08

Feasibility Study of Micro-undulator for T-ray Light Source Using FEM

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T-ray, the wavelength and frequency of which is 30 μm - 3 mm and 0.1 THz - 10 THz, respectively, is promising electromagnetic wave for the next generation because it is very safer than x-ray when human bodies are exposed to T-ray. Very intense T-ray light is normally generated by free electron laser (FEL). The principles of FEL are based on the fact that charged particles under accelerated motion generate electromagnetic wave. High energy electrons pass through the wiggler or undulator which is madeof permanent magnets in a way that the trace of electrons can be sinusoidal, for which upward and downward magnetic field should be successively repeated as shown in Fig. 1. Normally the size of FEL is very large because charge acceleration facility, undulator and geometric optic facility are large. For reduction of FEL small undulator is essential. In this study development of very small undulator is attempted by perpendicular magnetic recording technique, for which high coercivity magnetic thick films with several micron-meter thickness wereplaced on soft magnetic bulk materials. Beforemanufacturing micro-undulator the possibility of micro-undulator is tested by FEM simulation, in which appropriate recording materials, thickness, recorded wavelength could be optimized. $Co_{85}Cr_{15}$ and FePt thick films are chosen because these materials are relatively easier than other permanent magnets. Stray field from polycrystalline FePt is much stronger than that of $Co_{85}Cr_{15}$ films and a field stronger than 5,000 G can be obtained with a gap height of 50 m. Field distribution as well as its strength is important to improve the efficiency of FEL, for which sinusoidal variation of the stray field must be kept. Variation of total harmonic distortion (THD) was calculated with aspect ratio (= film thickness/ recording wavelength). With decreasing gap height the field variation becomes from sinusoidal to rectangular pattern as shown in Fig. 2. THD decreased with increasing aspect ratio as shown in Fig. 3. The properties of 4×30×2 mm primitive micro-undulator will be shown, for which 2.6 μm FePt films was sputtered on the Fe bulk and then annealed in a high vacuum of 1×10^{-5} torr in order to have ordered FePt phase. The undulator was then recorded with an iron single pole head. The recorded pattern and stray filed was measured with micro Hall probe and MOKE.

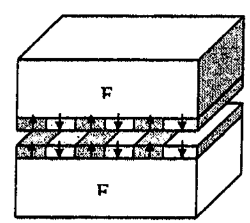

Fig. 1. Schematic diagram of undulator

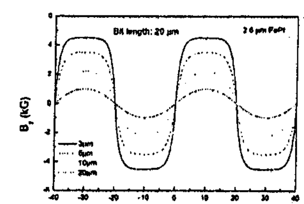

Fig. 2 Variation of perpendicular magnetic field.

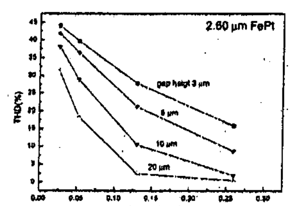

Fig. 3. Variation of total harmonic distortion with aspect ratio