Submicron Magnetic Particles of $Mn_{0.25}Fe_{2.75}O_4$ and Their Magnetorheological Characteristics

Ying Dan Liu[1,2], Yong Hui Li[3], Chul Sung Kim[3], and Hyoung Jin Choi[2]

[1]State Key Laboratory of Metastable Materials Science and Technology, Yanshan University, Qinhuangdao 066004, China
[2]Department of Polymer Science and Engineering, Inha University, Incheon 402-751, Korea
[3]Department of Physics, Kookmin University, Seoul 136-702, Korea

The single crystalline ferrite magnetic $Mn_{0.25}Fe_{2.75}O_4$ particles were synthesized via a solvothermal reaction method and applied as a magnetorheological (MR) material when being dispersed in a nonmagnetic oil. Field-emission scanning electron microscope (FE-SEM) and high-resolution transmission electron microscope (HR-TEM) measurements showed that the average size of the monodispersed particles was 344 nm with single crystalline spots in the selected-area electron diffraction patterns. The crystal structure was determined to be cubic spinel with a lattice constant $\alpha_0 = 8.398$ Å. According to the magnetization curves at 4.2 and 295 K, the saturation magnetization and coercivity of $Mn_{0.25}Fe_{2.75}O_4$ microspheres are determined to be 92.5, 72.8 emu/g, and 18.86, 4.53 kA/m, respectively. MR performance of the $Mn_{0.25}Fe_{2.75}O_4$-based MR fluid was measured by using a rotational rheometer with a parallel-plate geometry. Both controlled shear rate and controlled shear stress modes were applied to the loaded MR fluid sample at various magnetic field strengths. Dynamic and static yield stresses obtained from the two modes were compared and analyzed using a power law.

Index Terms—**Magnetization, magnetorheological fluid, $Mn_{0.25}Fe_{2.75}O_4$, yield stress.**