12TH JOINT MMM–INTERMAG CONFERENCE

January 14–18, 2013
Chicago, Illinois, USA

Intermag
2013
MMM

ABSTRACTS

IEEE MAGNETICS

AIP American Institute of Physics

THURSDAY MORNING, 17 JANUARY 2013 RIVERSIDE CENTER, 9:00 TO 12:00

Session EU
MAGNETIC FLUIDS AND APPLICATIONS I (POSTER SESSION)

Zoe Boekelheide, Chair

CONTRIBUTED PAPERS

EU-01. Mesoporous Fe-MCM-22 additive effect on magnetorheological response of magnetic carbonyl iron suspension.Y. Liu[1], X. Quan[1], W. Ahn[2] and *H. Choi*[1] *1. Department of Polymer Science and Engineering, Inha Univ, Incheon, Republic of Korea; 2. Department of Chemical Engineering, Inha Univ, Incheon, Republic of Korea*

Magnetorheological (MR) fluids are concentrated suspensions of magnetic particles, of which their rheological performances of shear viscosity, dynamic modulus, and yield stress are able to be significantly enhanced by the application of a magnetic field [1], thus possessing extensive engineering applications. Magnetic particles of iron, iron oxide and iron alloys are the most applied materials in MR fluids. However, all these candidates encounter serious sedimentation problem due to the large density mismatch between the particles and the carrier liquid. Non-magnetic particles in nano- or submicro-scale, such as fume silica, organoclay and graphene oxide, were used as additives in the MR fluid system to prevent fast settling of the magnetic particles [2-4]. There are also other problems accompanying with the introducing of the additives, e.g., higher off-state viscosity and lower yield stress than the MR fluid without the additive. In this study, we applied a mesoporous molecular sieve Fe-MCM-22 [5] with magnetic iron contained in the pores, in the carbonyl iron (CI)-based MR fluid. The Fe-MCM-22 was synthesized by a hydrothermal method reported before. Three MR fluids were prepared containing the same volume fraction of CI but different contents of Fe-MCM-22 (1, 3, 5 wt% according to the carrier fluid). MR performances of the MR fluids were measured by a commercial rotational rheometer including shear stress and shear viscosity in a steady shear flow and elastic modulus in an oscillatory measurement. The application of magnetic additive enhanced the MR effect (yield stress) of the MR fluid which was proportional to the component of the Fe-MCM-22, as shown in Fig. 1. Sedimentation rate was found to also reduced by the additives comparing to the MR fluid without Fe-MCM-22.

[1] B. J. Park, F. F. Fang, and H. J. Choi, Soft Matter 6, 5246 (2010). [2] S. T. Lim, M. S. Cho, I. B. Jang, and H. J. Choi, J. Magn. Magn. Mater. 282, 170 (2004). [3] H. B. Cheng, L. Zuo, J. H. Song, Q. J. Zhang, and N. M. Wereley, J. Appl. Phys. 107, 09B507 (2010). [4] W. L. Zhang and H. J. Choi, J. Appl. Phys. 111, 07E724 (2012). [5] S. T. Yang, J. Y. Kim, J. Kim, and W. S. Ahn, Fuel 97, 435 (2012).

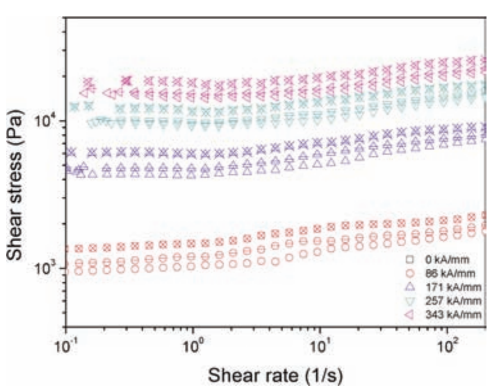

Figure 1. Flow curves of the CI MR fluids with Fe-MCM-22 of 1% (center open), 3% (center bar) and 5% (center cross) at various magnetic filed strengths.

EU-02. Sub-micron sized magnetic particles of Mn0.25Fe2.75O4 and their magnetorheological characteristics.Y. Liu[1], Y. Li[2], C. Kim[2] and *H. Choi*[1] *1. Department of Polymer Science and Engineering, Inha Univ, Incheon, Republic of Korea; 2. Department of Physics, Kookmin University, Seoul, Republic of Korea*

Ferrite magnetic particles (MxFe3-xO4, where M= Mn, Fe, Co, Ni, Cu, Zn), either in nano- or micron-scale, have attracted special attention due to their electromagnetic properties including high saturation magnetization, stability and low loss energy, and their wide technological applications [1]. Among these materials, MnFe2O4 has the inversed spinel structure to Fe3O4, and thus, a doping degree by Mn2+ to Fe3O4 can change the spin structure of the particles. However, in this study, we pay attention to the magnetic response of this kind of particles when dispersed in a viscous base-oil. The suspension is called a magnetorheological (MR) fluid, which is a smart material of magnetic particles in nonmagnetic liquid, possessing the ability of being changed from a liquid-like to a solid-like state upon the application of a magnetic field [2]. Monodispersed Mn0.25Fe2.75O4 sub-micron spheres [3] (200~400 nm) were synthesized by a solvothermal reaction method, possessing single crystal strucutes and excellent ferromagnetic property. The as-synthesized magnetic particles were then applied in an MR fluid with the particle fraction of 20 vol%. The MR fluid, measured by a rotational rheometer, showed good field-responsive property both in flow curves (Fig. 1) and dynamic oscillatin test: stepwise increase in shear stress and storage modulus. In addition, the Mn0.25Fe2.75O4 particles with smaller size than the commonly applied carboyl iron microparticles [4, 5] in MR fluid, are expected to ehxibit better setlling stablility, therefore introducing a new application field to the particles.

[1] J. H. Lee, J. Jang, J. Choi, S. H. Moon, S. Noh, J. Kim, J. G. Kim, I. S. Kim, K. I. Park, and J. Cheon, Nat. Nanotech. 6, 418 (2011). [2] B. J. Park, F. F. Fang, and H. J. Choi, Soft Matter 6, 5246 (2010). [3] Y. H. Li, T. Kouh, I. B. Shim, and C. S. Kim, J. Appl. Phys. 111, 07B544 (2012). [4] H. B. Cheng, L. Zuo, J. H. Song, Q. J. Zhang, and N. M. Wereley, J. Appl. Phys. 107, 09B507 (2010). [5] Y. D. Liu and H. J. Choi, J. Appl. Phys. 111, 07B502 (2012).

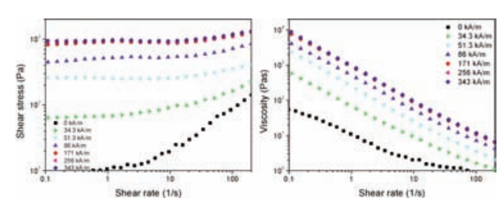

Figure 1. Shear stress and viscosity of hte Mn0.25Fe2.75O4 MR fluid as a function of shear rate measured at different magnetic field strengths.

EU-03. Thermal variation of MgZn-nanoferrites for magnetic hyperthermia.*S. Hyun*[1], H. Kim[2], M. Kim[1], K. Yoo[2] and C. Kim[1] *1. Physics, Kookmin University, SEOUL, Republic of Korea; 2. Nanomedical Graduate Program, Yonsei University, SEOUL, Republic of Korea*

A study on bio-applications for hyperthermia, drug delivery, magnetic resonance imaging and bio-sensors has been reported with the properties of a few nanometer size-materials, especially, ferrite materials [1-3]. In this research, the crystallographic and magnetic properties for $Mg_{1-x}Zn_xFe_2O_4$ (x=0.2, 0.4,