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PROGRAM

China National Convention Center

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HR-13. Preparation of Fe-based soft magnetic composites with high B_s by Acidic bluing coating. *G. Zhao*[1], C. Wu[1] and M. Yan[1] *1. Zhejiang University, Hangzhou, Zhejiang*

HR-14. Study of hyperthermia through the bio-plasma treatment and magnetic properties of Fe_3O_4 nanoparticles. *H. Choi*[1] and C. Kim[1] *1. Kookmin University, Seoul, Korea*

HR-15. Magnetically Recycle-able Pd-modified $NiFe_2O_4$ Nanoparticles. *S. Atiq*[1], S.M. Ramay[2], A. Mahmood[3], S. Riaz[1] and S. Naseem[1] *1. Centre of Excellence in Solid State Physics, University of the Punjab, Lahore, Lahore, Punjab, Pakistan; 2. Astronomy and Physics Department, Faculty of Science, King Saud University, Riyadh, Saudi Arabia; 3. Chemical Engineering Department, College of Engineering, King Saud University, Riyadh, Saudi Arabia*

FRIDAY AFTERNOON 1:30 — PLENARY HALL B

Session HS
NANOSTRUCTURED AND COMPOSITE HARD MAGNETIC MATERIALS II (Poster Session)

Minggang Zhu, Chair
China Iron & Steel Research Institute
Yikun Fang, Chair
China Iron and Steel Research Institute

HS-01. Analysis of Magnet Behaviors within High Frequency Field and High Temperature Using Micromagnetic Simulator. *F. Akagi*[1] and Y. Honkura[2] *1. Kogakuin University, Tokyo, Japan; 2. Magnedesign Corporation, Aichi-ken, Japan*

HS-02. Magnetic characteristics and microstructure of hot pressed $Pr_2(Fe,Co)_{14}B/PrCo_5$ hybrid magnet prepared by SPS. *D. Zhang*[1], C. Wang[1], M. Yue[1], Q. Lu[1], W. Liu[1], J. Sundararajan[2] and Y. Qiang[2] *1. College of Science and Engineering, Beijing University of Technology, Beijing; 2. Department of Physics, University of Idaho, Moscow, Idaho*

Study of hyperthermia through the bio-plasma treatment and magnetic properties of Fe_3O_4 nanoparticles

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I. INTRODUCTION

The ferrite magnetic nanoparticles have long been studied with various industrial application such as hyperthermia, bio-catalysts, high density magnetic storage[1]. Recently, Hyperthermia therapy has been in the spotlight with a high saturation magnetization and a small particle size[2,3].

In this paper, According to the plasma processing time, we have studied the magnetic and thermal properties of Fe_3O_4 nanoparticles under plasma treatment. Also, We have studied the crystallographic and magnetic properties of Fe_3O_4 with XRD, VSM, Plasma, Hyperthermia, and Mössbauer spectroscopy. Especially, we have focused on the saturation magnetization and self-heating temperature.

II. EXPERIMENT PROCEDURES

The Fe_3O_4 sample was fabricated by high temperature thermal decomposition (HTTD) method. 2 mmol of iron (III) acetylacetonate was used as starting materials and were mixed with 2 ml Oleic acid, and 3 ml Oleylamine and 20 ml of benzyl ether. The mixture was heated up to 298 ^{o}C for 30 min in air and was cooled to room temperature (RT). The obtained black magnetite particles were washed with ethanol three times. And then dired in vacuum at 12h. The crystal structure of samples was characterized by using X-ray diffraction (XRD) with Cu-$K\alpha$ radiation (λ = 1.5406 Å). The magnetic properties were investigated by vibrating sample magnetometer measurements (VSM). A bio-plasma equipment was used with argon and applied of 100 voltage for the plasma treatment. The sample exposure time under plasma. The exposure time were 0, 10, 20, 30, 40, 50, 60 min. Also, Sample exposed was measured by Self-heating temperature with magneTherm device. The ^{57}Fe Mössbauer spectra were recorded using a ^{57}Co source in the Rh matrix with the spectrometer moving at constant acceleration.

III. RESULTS AND DISCUSSION

The refined XRD patterns of Fe_3O_4 sample by the Rietveld refinement method. The crystal structure of Fe_3O_4 were determined to be cubic spinel with the space group of *Fd-3m* at room temperature. The lattice constant of samples was a_0 = 8.381 Å. The Bragg factors R_B and R_F were 3.02% and 1.76%, respectively. From the Scherrer equation for XRD pattern, the diameter of samples was 10.7nm. To obtain the magnetic properties of Fe_3O_4 samples, we performed VSM measurements. Fig.1 shows that the saturation magnetization enhance according to the plasma processing with saturation after 30 minutes. The saturation magnetization of exposed to the plasma 30 min was highest among the samples as 73.705 emu/g. Fig.2 shows the self-heating temperature under a time-varying magnetic field of 25 mT at 50 kHz. The self-heating temperature of the sample increases up to 94.6 ◦C after the plasma treatment 30 min. The Mössbauer spectra were obtained from 4.2 K to room temperature before and after plasma treatment. These were analyzed with tetrahedral A site and two six-lines for octahedral B_1 and B_2 sites, resulting in the three six-line hyperfine pattern. Based on the Plasma treatment, we expect that the magnetic properties of Fe_3O_4 nanoparticles with enhanced self-heating temperature.

References

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[3] D. H. Kim, D. E. Nikles, D. T. Johnson and C. S. Brazel, J. Magn. Magn. Mater. 320, 2390 (2008).

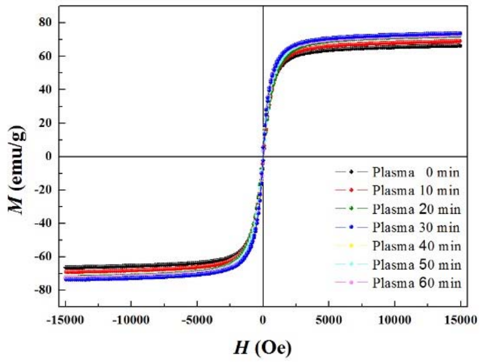

Fig.1 The saturation magnetization and corecivity of Fe_3O_4 nanoparticles were measured by VSM with a maximum applied field of 1.5 T at 295 K.

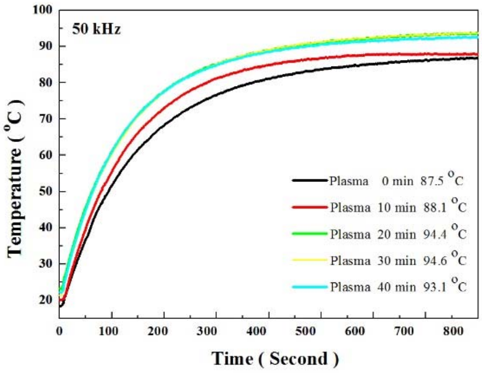

Fig.2 Self-heating temperature under time varying magnetic field of 250 Oe at 50 kHz.