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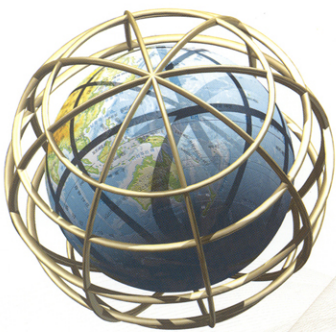

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Enhanced Ferromagnetic Properties of Diluted Fe Doped ZnO with Al Co-doping

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The transition-metal doped ZnO has drawn much attention for the suggested possibility of room temperature ferromagnetism in ZnO-based diluted magnetic semiconductor (DMS) [1]. The presence of magnetic ions such as 3*d* transition metal ions in these materials leads to an exchange interaction between itinerant *sp* band electrons or holes and the *d* electron spins localized at the magnetic ions, resulting in versatile magnetic field induced functionalities. We studied with an Al added and Fe doping novel II-VI oxide semiconductor, $Zn_{0.99-x}Al_{0.01}Fe_xO$ (x = 0, 0.02, 0.05) by solid reaction method, which has excellent magnetic properties and similar lattice constants to those of ZnO.

Al-added $Zn_{0.99-x}Fe_xAl_{0.01}O$ (x = 0, 0.02, 0.05) powders were prepared with annealing in Ar atmosphere at 1200℃. The crystalline structure for $Zn_{0.99-x}Fe_xAl_{0.01}O$ was determined with x-ray diffraction at room temperature. The magnetic property was studied of an applied field at various temperatures and temperature dependence of the moment curves by the vibrating sample magnetometer(VSM). The electric properties were characterized by a temperature dependence of resistance and Hall measurement.

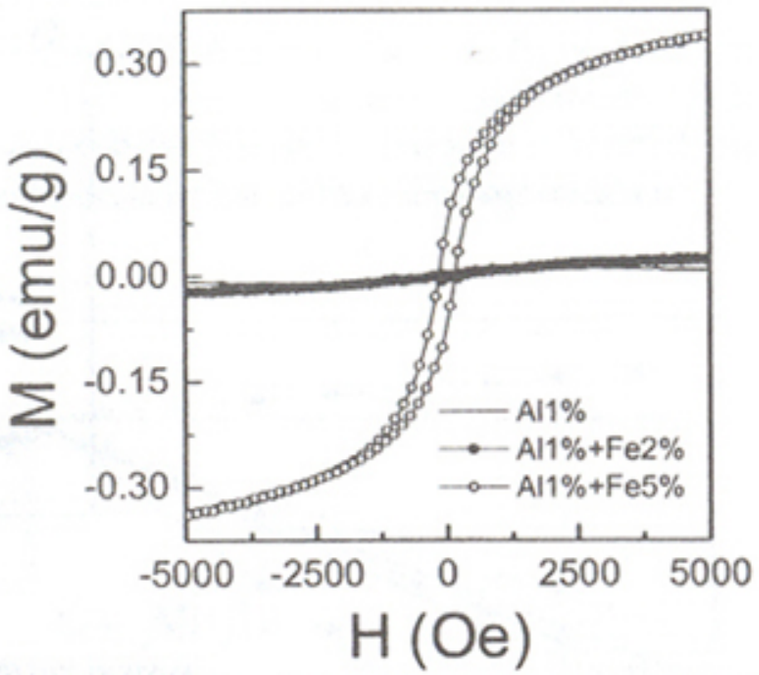

Fig. 1: The Hysteresis Loops for Diluted Fe-Ion Doped ZnO Powder at Room Temperature.

The x-ray diffraction patterns of the Al-added ZnO based Fe doped samples showed a wurtzite single phase, without any segregation of Fe or Al. The lattice parameters for the $Zn_{0.94}Fe_{0.05}Al_{0.01}O$ were a_0 = 3.254 and c_0 = 5.209 Å at room temperature. The hysteresis curve for the $Zn_{0.94}Fe_{0.05}Al_{0.01}O$ at room temperature was indicated to the ferromagnetic phase as shown in Fig. 1. As the $Zn_{0.94}Fe_{0.05}Al_{0.01}O$, the ferromagnetic effect was explained to increasing exchange interaction between the neighboring magnetic polaron due to the carrier concentration increasing. The temperature dependence of magnetization curve is measured from 60 to 350 K and indicated that the Curie temperature has above the room temperature. The temperature dependence of resistance curve of all samples was shown magnetic semiconductor behavior.

REFERENCES

[1] Dietl, H. Ohno, F. Matsukura, J. Cibert, D. Ferrand, *Science*, vol. 287, 1019 (2000).