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Magnetization Behavior and Magnetic Entropy Change on FeZrMn Alloys

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Room temperature magnetic refrigeration is a new highly efficient and environmentally protective technology. Although it has not been fully developed, it shows great applicable prosperity and seems to be a substitute for the traditional vapor compression technology. So, an important task of applied physics is to search for new magnetic materials which exhibit a significant magnetic entropy change. Amorphous materials with low Curie temperature have many useful properties that are attractive for use in many applications but not as magnetic refrigerants at room temperature because the Curie temperature is low.

In our work, magnetization and magnetocaloric effect of $Fe_{90-x}Mn_xZr_{10}$ (x = 0, 4, 6, 8) compounds were investigated. These kind of materials with low Curie temperature have many useful properties that are attractive for application as magnetic refrigerants[1,2]. Samples were prepared by single roller melt spinning under argon atmosphere and annealed at 200, 300, and 400^{o}C. For various temperatures near the Curie temperature, we measured magnetization as a function of the magnetic field. Critical behavior study, which relates thermodynamic quantities near ferromagnetic(FM)-paramagnetic(PM) phase transition, have been performed in order to understand the nature of the magnetic phase transition near the Curie temperature and type of magnetic ordering. From the magnetization data, the magnetic entropy change for isothermal magnetization was calculated by applying the thermodynamic Maxwell equation to the magnetic system. As Mn content increases, the Curie temperature decreases and the maximum entropy change (ΔSM) is seen around the Curie temperature. Our results show that the FeMnZr alloys exhibit a good magnetocaloric effect, indicating that these alloys can be considered as candidates for magnetic refrigeration applications. In comparison with pure Gd metal, these alloys are much cheaper, their Curie temperature can be easily adjusted by tuning the Mn concentration.

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Local Ordering Study of Nanostructure FeMnAl Alloys

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FeMnAl alloys were fabricated by the mechanical alloying process. The structural and magnetic properties of the alloys were studied as a function time. The local structural change of FeMnAl has been investigated by means of X-ray diffraction (XRD), extended x-ray absorption fine structure (EXAFS) and Mossbauer spectroscopy. The magnetic properties were measured using vibrating sample magnetometer (VSM) at room temperature. With increase the milling time, the XRD patterns were broadened and the intensity was reduced. The XRD pattern for 24-hours alloyed FeMnAl powders exhibited bcc structural phase. The local structure and atomic ordering were examined by EXAFS experiment. The EXAFS spectra were obtained at Fe K-edge. The radial atomic density in a real space can be shown in the Fourier transformed spectrum [1]. Fourier transform of EXAFS spectra for FeMnAl alloys exhibits the local ordering of Fe central atom which was changed with increase of milling time. The first shell of Fourier transformed spectra was shifted to short atomic range corresponding to the formation of alloy. The Mossbauer spectrum showed typical sextets in the 1-hour milled sample corresponding to α-Fe spectrum. Increasing the milling time, the sextets become broader due to appearance of disordered Fe atoms in both solid solutions. The hyperfine field distributions were decreased as increasing milling time, which is similar trend with magnetization distribution.

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