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PROGRAM AND ABSTRACTS

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Mo-D-9.5-14

Irreversibility Effects in First-order Magnetic Phase Transitions and Deviations on Estimating the Magnetocaloric Effect

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We show how the anomalous magnetic entropy change peak obtained from magnetization measurements in some first-order magnetic phase transition materials may result from the usual data analysis procedure, consisting on using a Maxwell relation, which does not take into account magnetic irreversibility or mixed-phase regime. We model the stable and metastable states of a first-order magnetic phase transition, from the use of the Landau theory of phase transition and the molecular mean-field model, and estimate magnetic entropy change by the usual method. The deviations produced are comparable to anomalous effects discussed in the literature and may even exceed the theoretical limit. Our results show that this anomalous magnetic entropy change peak should not necessarily be interpreted as a consequence of the particular physics of the studied system. This also explains the absence of the large magnetic entropy peak effect in values obtained from specific heat measurements.

Mo-D-9.5-15

Magnetocaloric effect in ferrimagnetic systems under first and second order phase transition.

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Due to the possibility of technological applications of the magnetocaloric effect (MCE) on magnetic refrigeration around room temperature, which does not present hazardous effects, the interest on the MCE had grown on in the last twelve years [1]. The MCE is usually observed when a magnetic field is applied on a magnetic material, which can warm up or cool down in an adiabatic process. In this work we present a model to describe the MCE in ferrimagnetic arrangements. Our model takes into account the magnetoelastic interaction, which can lead to the onset of the first order magnetic phase transition and the giant MCE. Several profiles of the MCE, such as: the inverse [2] and giant MCE [1] were systematically studied. Application of the model to the rare earth iron garnets systems is discussed.

[1] K. A. Gschneidner Jr. and V. K. Pecharsky, Int. J. Refrigeration, **31** (2008) 945.
[2] Thorsten Krenke et. al., Nature Materials, **4** (2005) 450.

Mo-D-9.5-16

Magnetism and magnetocaloric effect in seven samples of $La(Fe_{1-x}Co_x)_{11.9}Si_{1.1}$ $(0.055 < x < 0.122)$*

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The magnetocaloric effect, i.e. the temperature change of a material when a magnetic field is applied, may be utilized for magnetic refrigeration near room temperature. As the effect is largest around the transition temperature the refrigerant material should show a magnetic transition near room temperature as well as possess other suitable characteristics such as little to no hysteresis. Seven samples of the ferromagnetic materials $La(Fe_{1-x}Co_x)_{11.9}Si_{1.1}$ with $0.055 < x < 0.122$ have been characterized. The change in composition means that the materials show Curie temperatures, T_c, in the range $250 - 280$K. Various experimental data such as heat capacity measurements in applied fields up $\mu_0 H = 1.2$ T and magnetization measurements provide information on the magnetism and magnetocaloric effect present in these materials. As the Co content increases, T_c increases, the magnetocaloric effect decreases and the character of the magnetic phase transition changes.

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Mo-D-9.5-17

Intensive and extensive magnetocaloric effects in manganites $(La_{1-y}Eu_y)_{0.7}Pb_{0.3}MnO_3$ *

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In recent years one of the most intensively investigated problems actual from fundamental and practical points of view is associated with searching for new promising materials for cooling cycles on the basis of magnetocaloric effect (MCE). Manganites based on $LaMnO_3$ and exhibited a lot of interesting and useful physical properties are considered as solid state refrigerants competitive with well known Gd.
The present paper is devoted to studies of MCE in $(La_{1-y}Eu_y)_{0.7}Pb_{0.3}MnO_3$ (y = 0; 0.2; 0.4; 0.6) compounds. For this aim we have investigated the heat capacity, intensive and extensive MCE by means of adiabatic calorimeter and PPMS. The most attractive property of materials under study is associated with a possibility to synthesize a series of solid solutions with the working temperature regulated in a wide range. The relative cooling power of $(La_{1-y}Eu_y)_{0.7}Pb_{0.3}MnO_3$ compounds was determined showing promise and discussed in combination with that for other manganites.

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Mo-D-9.5-18

Investigation of the magnetic order in magnetocaloric $FeMnP_{1-x}Si_x$ alloys

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The magnetic ordering of $FeMnP_{1-x}Si_x$ alloys was investigated. FeMnPSi alloys are good canditates for magnetocaloric applications as they display excellent magnetocaloric properties which can be tuned easily [1]. The $FeMnP_{1-x}Si_x$ samples were prepared by drop synthesis method and subsequent heat treatment. SQUID magnetisation measurements, X-ray diffraction and Mössbauer spectroscopy were carried out to investigate the magnetic and structural properties. Calculations using the local density approximation (LDA) have been performed to determine the magnetic configuration of the ground state. The nominal compound $FeMnP_{0.75}Si_{0.25}$ shows ferromagnetic behavior after quenching and antiferromagnetic behavior after heat treatment and smooth cooling. This behaviour is due to order/disorder in the distribution of Fe and Mn atoms depending on the cooling procedure.

[1] *Cam Thanh et al., J.Appl.Phys.* ***103****, 07B318 (2008).*

Mo-D-9.5-19

Magnetization Behavior and Magnetic Entropy Change on annealed FeMnZr 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 annealed $Fe_{90-x}Mn_xZr_{10}(x = 0, 4, 8)$ compounds were investigated. These materials with proper Curie temperature have many useful properties that are attractive for application as magnetic refrigerants. Critical behavior study, which relates thermodynamic quantities near ferromagnetic-paramagnetic 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. As Mn content increases, the Curie temperature decreases and the maximum entropy change 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 and annealing process.