Moscow International Symposium on Magnetism

1 – 5 July 2017

Book of Abstracts

M.V. Lomonosov Moscow State University, Faculty of Physics

Main Topics

Spintronics and Magnetotransport
Magnetophotonics
High Frequency Properties and Metamaterials
Magnetic Nanostructures and Low Dimensional Magnetism
Soft and Hard Magnetic Materials
Magnetic Shape-memory Alloys and Magnetocaloric Effect
Magnetic Semiconductors and Oxides
Multiferroics
Magnetism and Superconductivity
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GIANT MAGNETOCALORIC EFFECT IN COMPOSITES BASED ON POLYMERIC MATRIX AND MANGANESE ARSENIDE

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The composite material which is made of metallic and polymeric material by certain processes, can retain the advantages of the original components, overcomes some shortcomings and show some new properties. A composite material is a multi-phase system consisted of matrix material and reinforcing material. Matrix material is a continuous phase, and reinforcing material is a dispersed phase, such as fiber, sheet or particle. The composite not only retains the key feature of the original component materials, but also gets the performances that are not depicted by the original components through the combined effects.

Various functional materials can be produced by compounding different materials of function. At present, electromagnetic functional materials develop most rapidly and are used most commonly in the functional composite materials. These composite materials can be processed into magnetic products with the required shape and the certain mechanical properties by the general forming methods (such as compression molding, laminating, etc.) of polymeric materials. In order to obtain a good overall performance, we must increase the amount of filler or enhanced material as much as possible, control the interface of composite materials and make composite materials have better process ability.

It is known, that MnAs is a ferromagnetic, which demonstrates first order phase transition in both magnetic and structural subsystem near room temperature. The temperature dependence of MCE shows a wide hysteresis which blocks of its application. It was shown that both ferro- and paramagnetic metastable phase coexist in MnAs in the region of phase transition, and so the MCE is caused by magnetic phase transition from paramagnetic to ferromagnetic state.

In this work the polymer matrix composites with MnAs powder as reinforcing material were obtained. The aim of this paper is to investigate the influence of both polymeric matrix type and processing methods of composite to the temperature behavior of magnetocaloric effect (MCE) and finding the dependence of MCE and unstable magnetic condition to be produced by thermal and magnetic history of sample. The nanosize particles composites were also investigated.

The composites were prepared from nano- and microsrystalline metallic powder fixed in polymeric matrix; the volume of polymer is less than 8%. There were obtained both textured by magnetic field and isotropic samples fixed by hydrostatic pressure up to 20 kbar.

A bulk MnAs demonstrates a strong temperature and field hysteresis of magnetic properties in magnetic field less than 50 kOe. The maximum value of MCE is $\Delta T = 0.28$ K on heating (at 308 K) and $\Delta T = 0.88$ K on cooling (at $T = 306$ K) for MnAs in magnetic field 10 kOe.

It was shown, that the decreasing of grain size less than 1 μk leads to reduction of the MCE in nanosized composites. It was found, that both the hysteresis and maximum value of MCE are increased in textured composites in compare with bulk MnAs.

It is established that the optimum properties, such as giant MCE and low temperature hysteresis, are found in composite with ~1μm particles and polyvinyl acetate matrix hardened at pressure of 10kBar. The maximum of MCE in this composite is $\Delta T \sim 1,3$ K (at 309 K) in 10kOe. These properties are caused by the residual pressure of polymer mold on grains.

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