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Fabrication and Magnetic Properties of Ordered Co Nanowire Arrays Electron-Beam Deposition in AAO Templates

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Anodic aluminium oxide (AAO) template was used to prepare highly ordered Co nanowire arrays. AAO template has ordered hexagonal cells and the nanopores array was uniform and regularity with perfectly parallel pores. Highly ordered nanowires with uniform diameter, deposited on the AAO template, are essential to study their properties. Especially, a few metal nanowire arrays have been intensively investigated for their use as high-density magnetic recording devices [1, 2] and sensors [3, 4]. The physical properties of nanowires were strongly related to their structures and arrangement, such as length, diameter and separated distances [5]. In our recent work the AAO template was prepared following the two-step anodization procedure [6] and modified the procedure to improve the nanopore regularity of the AAO template [7]. Co nanowire arrays using AAO template was fabricated by electron beam deposition. We have investigated the influence of the deposition conditions on the structure of the Co nanowires with variation of the pore diameter, which was controlled by widening time and electrolytes. The AAO template diameter was 120 nm with thickness 160 nm. The pore diameter was varied with 90 nm, 60 nm and 30 nm respectively. The morphologies of deposited Co nanowires were obtained by scanning electron microscope (SEM). Magnetic properties of Co nanowires were measured by ferromagnetic resonance (FMR) and SQUID magnetometer. The exchange interaction between pores was analysed by FMR spectrum as a function of pore diameter. The exchange interaction was increased with the increase of pore diameter. Temperature dependence of magnetization was also showed different intrinsic magnetic property with varying the pore diameter. The magnetic properties of the nanowire samples were explained with compared to that of the continuous Co thin film.

Keywords: Anodic Alumina, Co nanowire arrays, Electron-beam deposition, Ferromagnetic resonance

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Magnetic Properties and Magnetocaloric Effects on Ni-Fe-Sb Semi-Heusler Alloy

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Room temperature magnetic refrigeration is a new highly efficient and environmentally protective technology. Although it has not been maturely developed, it shows great applicable prosperity and seems to be a substitute for the traditional vapor compression technology. So, a research for new magnetic materials, which exhibit a significant change in the magnetic entropy in response to the change of magnetic field under isothermal conditions, has become an important task of the applied physics.

Heusler alloys have many useful properties that are attractive for application as magnetic refrigerants[1]. For this purpose we studied the $NiFe_{1-x}Sb_x$ alloys. Samples were prepared by conventional arc melting method in argon atmosphere. For homogeneity of samles, ingot was melted several times. And then, the heat treatment was carried out at 1100 K in a sealed quartz tube for 7 days and quenched in ice water. Quenching is believed to be important to obtain a high chemical order for this kind of alloys. We measured the temperature dependence of magnetization behavior depend on applied field. Critical behavior study, which relate thermodynamic quantities near ferromagnetic (FM) - paramagnetic(PM) phase transition, have been performed in order to understand the nature of the magnetic phase transition at the near of Curie temperature and type of magnetic ordering. The large magnetocaloric effect can be expected near the order-disorder phase transition of a magnetic materials. From the magnetization data, the magnetic entropy change (ΔS_M) for isothermal magnetization was calculated by applying the thermodynamic Maxwell equation to a magnetic system [2]. As Sb content is increased, Curie temperature is decreased and, the maximum entropy change and adiabatic temperature change is seen about Curie temperature in all samples. Our results show that the Ni-Fe-Sb alloys have a good magnetocaloric effect, indicating that these alloys can be considered as candidates for magnetic refrigeration applications.

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