AS04

Constriction of Ferromagnetic Patterned Thin Film by Using AFM Nano Scratch Process

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Nanofabrication technique using a scanning probe microscope (SPM) has attracted much interest. The atomic force microscopy (AFM)-based nanolithography is a promising approach for fabricating electron devices with nanometer-scale well defined structures. The fabrication of magnetic nanostructures is significant for developments of magnetic devices such as spin-related devices. Recently, it was reported that a magnetoresistance (MR) ratio as large as approximately 140% was successfully achieved on a nano-constricted part the area of which was about 1 nm^2. In order to fabricate the nano-constricted part, we have developed an AFM nanolithography process for patterning a photo-resist.

In this paper, scratch nanolithography of resist pattern by using AFM was studied. Figure 1 shows the schematics of fabricating the nano-constricted part on the NiFe. The photo-resist coated on the NiFe thin film was removed by scratching the resist by the scanned cantilever. After the sample was etched by dry etching process, nano-constricted part was fabricated on the patterned NiFe thin film. Fig 2 shows the nano-wire resist pattern after the scratching process by using AFM. The details of fabrication condition for resist scratching and characterization of the patterned films are also reported.

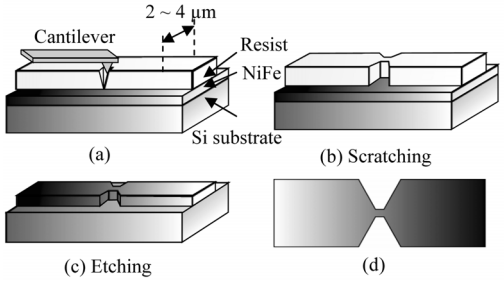

Fig. 1. Schematics of fabrication process of scratching photo resist using atomic force microscope.

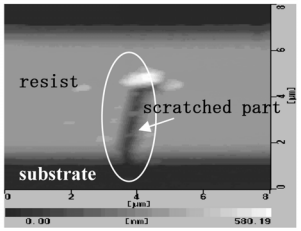

Fig. 2. AFM image of scratched part of resist pattern.

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AS05

An Investigation of Weak Magnetic Anisotropy in Ag Nanoparticles

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A weak magnetic anisotropy was observed in the thermal deviation of the saturation magnetization of Ag nanoparticles with an average diameter of 10.2 nm. The thermal deviation of the saturation magnetization is a clearly departure from the Bloch $T^{3/2}$-law expected for isotropic systems, signaling the onset of magnetic anisotropy, and is presumably due to the high surface-to-volume ratio of the nanoparticles. We propose a uniaxial anisotropy and adopt the Heisenberg ferromagnetic model for the H_a-aligned moments in the spin correlated shell of nanoparticles [1-2]. A magnetic anisotropic energy gap Δ=0.31(1) meV can then be obtained from the fit, which is about two orders-of-magnitude smaller than the exchange energy. This anisotropic energy gap corresponds to a thermal energy of 3.8 K or a magnetic energy of 2.4 T, reflecting that the anisotropic energy gap can only be revealed at low temperatures and low applied magnetic fields. Details of the thermal evolution of the magnetic behavior will be discussed.

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