

Fabrication and properties of magnetic films with nano-scaled artificial structures by means of AFM anodization technique

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By using method of anodization with an atomic force microscope (AFM) [1], an oxidized pattern can be fabricated on a sample surface without exposure and etching process, with low energy as compared with the method of electron beam lithography. In the case of a magnetic thin film, fabrication of an oxide dot on a NiFe thin film by the anodization was reported has been reported recently [2]. In this article, we study the method of AFM nano oxidation on a Ni magnetic film to fabricate a nanoscale magnetic structure.

The Ni and Fe thin films were prepared RF magnetron sputtering method on a SiO₂/Si substrate. The nano-oxidation pattern on the film was fabricated by applying a negative bias voltage to a Pt-coated conductive AFM cantilever. During nano-patterning, relative humidity inside an experimental chamber was controlled by bubbling nitrogen gas through pure water

The flatness of the sample surface was the critical factor in this experiment. An average roughness of our fabricated Ni film surface was 0.28 nm. As an example, we fabricated an oxidized grid pattern on the Ni surface with a bias voltage of -10 V, a line-patterning speed of 10 nm/s and relative humidity of 60 %. An average width and height of the fabricated line were 20 nm and 3 nm; the area surrounded by the anodized line was 40x40 nm². As the results, we fabricated the Ni nanoscale structures successfully by the method of AFM nano oxidation. Magnetic properties of the nano structure would be discussed.

References

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