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AAO에의한 나노로드 제작

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Fabrication of nano-rod on AAO template

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Abstract

Anodic aluminum oxide (AAO) which prepared with two-step anodizing method (with dissimilar solutions) was used as a template to fabricate highly ordered, free standing metal nano-rods. AAO nano-template technique can realize self-organized hexagonal pore structure with nanometer dimension size, it's easy to control pore diameter, length and density by varying anodizing conditions. Ni and Ni/Fe/Cu multi-metal layer nanorods were electrochemically deposited into AAO nano-template by AC voltage in simple sulfate solutions.. The properties of samples are tested by X-ray diffraction (XRD), field emission microscopy (FE-SEM).

Key Words: anodic aluminum oxide (AAO), multi-metal layer nanorods, nano-template, cylindrical pores

1. 서 론

Nowadays fabrication and characterization of magnetic nanostructured arrays has involved great interest as one of the important fields in modern science. Because of their potential applications in high density magnetic memory [3], giant magneto resistance (GMR) sensors [4,5], and magneto-electronic devices [6,7]. Fabrication of nanostructures with nanometer dimension is the starting point of nanotechnology research.

Anodic aluminum oxide (AAO) nanotemplate has been widely used to prepare nanowire arrays because of their self-organized, honeycomb-shaped, cylindrical and uniform holes can be controlled by changing anodizing conditions and and subsequent procedure. This character is favorable for perpendicular magnetic recording and patterned media.

In this paper, we present successful results for fabrication of free standing multi-metal layer nanorods and AAO via anodization process using dissimilar solutions in two step anodizing method. Electrodeposition is employed to fabricate nanorods in the AAO template. The high density of the AAO pores permits the high storage density.

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2. 실험 방법

Ordered porous alumina templates were prepared via anodization process using dissimilar solutions in two step anodizing method. In anodizing step was used specially prepared equipment (Fig.1.). Aluminum forms a porous oxide with uniform and parallel pores was anodized in an acidic electrolyte. The holes interval of anodic alumina porous, in other words the cell size, is determined by the applied voltage used for anodization. In this case, an annealed aluminum sheets was anodized in 0.3 M Oxalic acid for 1 h at 5° and a voltage 50V for 1st step and 10wt% Phosphoric acid for 15min at 5° to to get an AAO template.

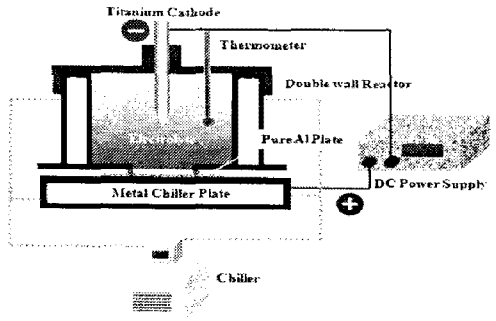

Fig. 1 Anodizing technique for fabrication of AAO nanotemplate

The average diameter of the pores is about 40 nm. Ni and Ni/Fe/Cu multi-metal layer nanorods were electrodeposited into the template with method showed in Fig.2.

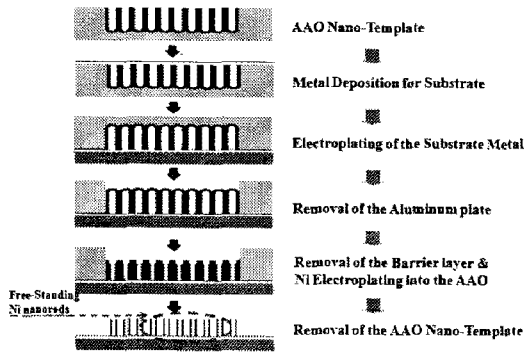

Fig.2 Basic method for fabrication of free standing Ni nanorods

The electrolyte to deposit nanorods had the following compositions: Ni ($NiSO_4 \cdot 6H_2O$, 300g/l; $NiCl_2 \cdot 6H_2O$, 45g/l; H_3BO_3, 45g/l), Fe ($FeSO_4 \cdot 7H_2O$, 120g/l; H_3BO_3, 45g/l), Cu ($CuSO_4 \cdot 5H_2O$, 125g/l; H_2SO_4, 100g/l) and saccharin as an additive. Deposition was carried out at room temperature with an AC voltage 0.5A using similar metal rods for each nanorods and AAO template with aluminum plate as working electrode.

3. 결과 및 토의

Fig.3 shows FE-SEM photographs of AAO anodized with different solutions in two step anodizing method using 1st-Oxalic acid and 2nd-Phosphoric acid with similar conditions for anodizing step. We can find that this photograph shows AAO nano pores has highly ordered and uniform holes. It shows that it's also possible to make anodizing of Al with two kinds of solutions to prepare AAO.

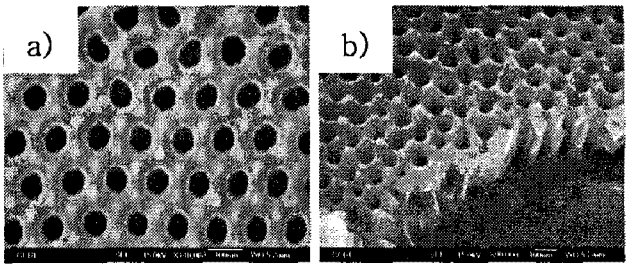

Fig.3 FE-SEM photographs of AAO anodized with dissimilar solutions in two step anodizing method, a) top view b) cross section view

Fig. 4 shows FE-SEM photographs of electroplated, free standing nickel nanorods and Ni/Fe/Cu multi-metal layer nanorods after removing AAO nanotemplate .

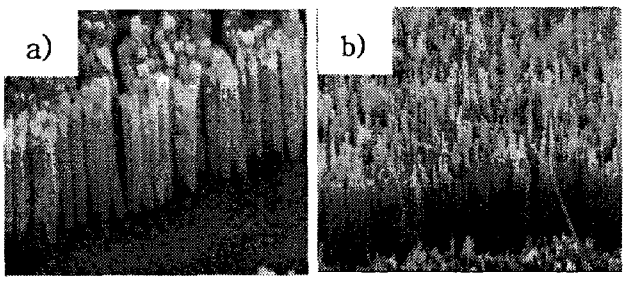

Fig. 4 FE-SEM photographs of a) nickel nanorod and b) Ni/Fe/Cu multi-metal layer nanorod

4. 결 론

In conclusion, we have fabricated AAO nano template using dissimilar solutions in two step anodizing method and ordered Ni/Fe/Cu multi-metal layer nanorod with an average diameter of nanorods 40nm successfully by DC

electrodeposition in AAO nano template.

The mechanism of the magnetic properties and magnetic variety of these nanorods should be attributed to special structure of the nanorods/AAO.

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