MAGNETIC PROPERTIES OF CoCrPt NANODOTS ARRAY MADE BY PS-PMMA BLOCK COPOLYMER TEMPLATE

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블록 공중합체를 이용한 CoCrPt 나노점 배열의 자기적 성질 연구

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I. INTORDUCTION

CoCrPt alloy films are attracting wide attention for applications to high-density magnetic recording media and hard magnetic layer in spin valve structure due to their high coercivity and strong magnetocrystalline anisotropy. Diblock copolymer templates are one of the most promising candidates for nanoscale patterning otherwise inaccessible by lithographic procedures [1]. In this study, we have investigated magnetic properties of $Co_{68}Cr_{18}Pt_{14}$ nanodot arrays made by self-assembling polystyrene-block-methyl methacrylate ((PS-b-PMMA), (Mn = 82.5 Kg/mol, with a 1.12 polydispersity)) diblock copolymer.

II. EXPERIMENTS

In this study, PS-b-PMMA made by Polymer Source, Inc. was used. The volume fraction of PMMA was 13.6 %. The block copolymer was mixed with toluene at 1% (w/w) concentration. The specimens were annealed under vacuum at $160^{O}C$, which was above the glass transition temperature of PS-b-PMMA blocks for 30 hr. The morphology was quenched by liquid nitrogen. The porous structure was obtained from the oriented polymeric template by ultraviolet (254 nm) photoirradiation of the thin polymeric film [2]. To image the copolymer film internal microstructure with a scanning electron microscope (SEM), the free surface wetting layer was removed by reactive ion etching. The etching process was performed under a CF_4 flow at a pressure of 20 mTorr and power density of 80 W. The CoCrPt films were prepared at ambient temperature by dc magnetron sputtering under a base pressure of 8×10^{-7} Torr and Ar sputtering pressure of 3 mTorr. Typical deposition rate, obtained under an applied power of 150 W to each target and a target-to-substrate distance of 50 mm, was 1.9 Å/s.

III. RESULTS AND DISCUSSION

A 35 nm thin film was produced by spin coating a 1% solution at 3000 rpm. The surface of this sample was clean, flat in the large area, and any nanopattern was not shown because the holes were submerged below the surface and cannot be imaged. However, after we used CF_4 reactive ion etching (RIE) to image the pattern beneath the surface, which expose the underlying nanopattern, we could see well-ordered holes (hexagonally ordered holes) as shown Fig. 1(a). The diameter of holes is about 18 nm, and center to center distance is about 38 nm. The aspect ratio is about 1. The size of hole could be changed from 13 to 20 nm by varying etching condition. The CoCrPt thin films were deposited on this self-assembled polymer surface. Fig 1(b) shows 9-nm-thick layer of CoCrPt metal alloy deposited onto nanoporous polymer template pattern. The size and ordering is replica of polymer template as shown Fig. 1(b). In this step, the washing treatment was applied to remove the

residue of metal onto the surface to prepare isolated metal dots.

Fig. 2 shows a magnetic hysteresis loop measured by magneto-optical microscope magnetometer (MOMM) for the samples of 6-nm CoCrPt/PS-PMMA/Si(100) and 6-nm CoCrPt/Si(100). As shown in Fig. 2, perpendicular magnetic anisotropy (PMA) of CoCrPt films is strongly enhanced when the film is deposited on nanopatterned PS-PMMA polymer. The squareness ratio, defined as the remnant Kerr rotation angle divided by the saturation one, increases from 0.41 to 0.85 for the samples of 6-nm CoCrPt/PS-PVP/Si(100) and 6-nm CoCrPt/Si(100), respectively. The enhanced PMA in CoCrPt nanodot arrays might be ascribed to the magnetostatic effect, since a demagnetization factor of ellipsoidal magnetic dot is smaller than continuous flat film.

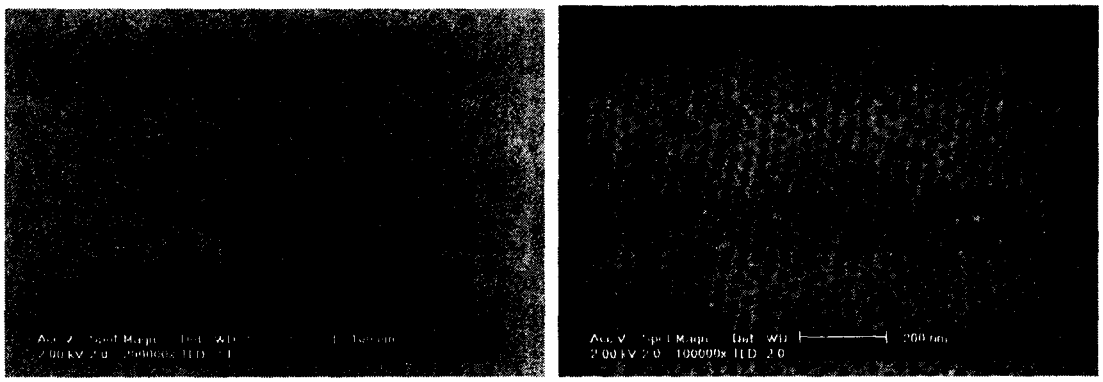

Fig. 1. (a) SEM image of nanoporous PS-PMMA (b) SEM image of 9-nm CoCrPt on nanoporous PS-PMMA.

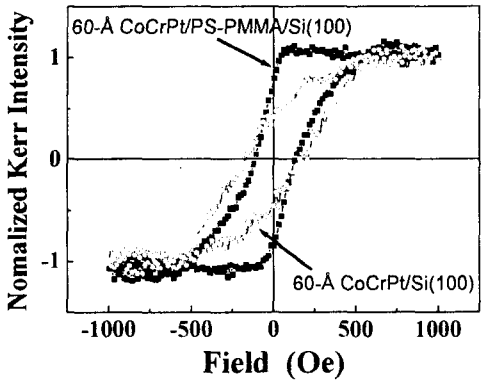

Fig. 2. MOKE hysteresis loops of 6-nm CoCrPt/PS-PMMA/Si(100) and 6-nm CoCrPt/Si(100) films.

IV.ACKNOWLEDGEMENT

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V. REFERENCES

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