Magnetic properties of electrodeposited CoPtP/Cu multilayers

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1. Introduction

Electrodeposited CoPtP thin films[1,2] for ultra high density recording media and MEMS have been studied extensively in order to overcome the thickness limitation that the inherent high coercivity of CoPtP is impossible to be maintained with increasing thickness (more than 1 μm)[3,4]. In this study we have electrodeposited CoPtP/Cu multilayers on (100) Si wafers, which enable to produce CoPtP films with high saturated magnetization(M_S), while their coercivities were kept high.

2. Experimental

Electrodeposition of $[CoPtP/Cu]_n$ multilayers was carried out by Dual Bath Technique (DBT)[4] which alternates Bath 1(CoPtP solution) with Bath 2(Cu solution). Bath 1 was a mixed solution of $CoSO_4$, H_2PtCl_6, $Na_3H_2PO_2$, and $Na_4P_2O_7$. Bath 2 consisted of $CuSO_4$ and $Na_4P_2O_7$. Single layer and multilayer were deposited using 1000 Å thickness Au layer on (100) Si wafer as a cathode. Deposition parameters were: pH = 8.3 adjusted with NaOH and H_2SO_4, T = 40 °C, Current density = 0.5 A/dm^2, quiescent bath. Magnetic hysteresis loops of multilayer and single layers were measured by a vibrating sample magnetometer (VSM) with an applied magnetic field perpendicular to the film plane. The composition of the samples was ascertained by energy dispersive X-ray spectroscopy (EDS).

3. Result and discussion

Fig.1 and Fig.2 show VSM histeresis loop for sample $[CoPtP(0.3\ \mu m)/Cu(0.1\ \mu m)]_{10}$ multilayer and CoPtP single layer(3 μm).

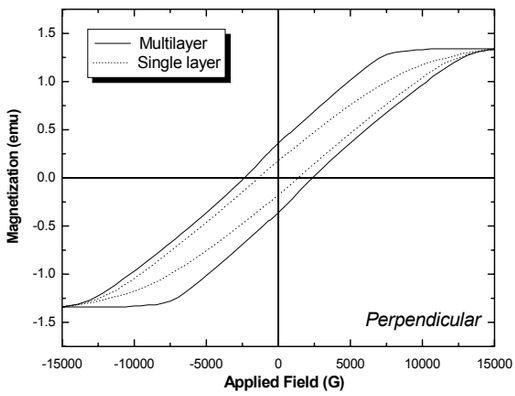

Fig 1. Hyteresis loops of perpendicular direction from CoPtP multilayer and single layer films.
The difference in coercivity is due to thickness differences between multilayer and single layer.

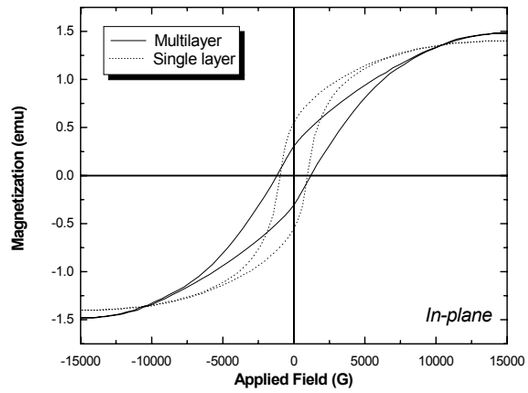

Fig 2. VSM histeresis loop for samples in in-plane direction.

The single layer loop shows that easy direction changed to in-plane direction by increasing thickness of films. This result can be expected that mutilayer maintained fine grains of CoPtP film to perpendicular direction.

4. Conclusion

CoPtP layers with a preferred crystallographic orientation (less than 1 μm) show high coercivity, but above that thickness their high coercivity drastically decreases. This phenomenon can be attributed to the increase in grain size. When CoPtP films were fabricated as multilayers in this work, it is possible to remain high coercivity of CoPtP films with increasing electrodeposited layers. Especially, thick films of CoPtP multilayer give possibilities for applying multilayer in MEMS.

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