Materials Science

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Interface and internal atoms in Pt/Fe multilayers studied by magnetic Compton scattering

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Introduction

Pt/Fe multilayers have been reported to show a perpendicular anisotropy [1] and soft magnetic properties [2] with the thin Fe layer thickness. Furthermore it has been reported that Pt/Fe multilayers have an fcc Fe phase with thin Fe layer thickness [2]. The Pt polarization and enhanced Fe magnetic moment are expected from the theoretical calculation in Pt-Fe alloy system [3]. These characteristic Fe are of importance not only for a fundamental science but also industrial applications such as a data storage media and high frequency magnetic devices. However the electronic structures of the Pt/Fe have not been clear.

In this paper we report on MCPs of the Pt/Fe multilayer. From analyses of layer thickness dependences, the MCPs are separated into interface atom contributions and internal atoms contributions.

Experimental

Thwo series of multilayers, [Pt(2.0nm)/Fe($x$nm)] (y=0.9 and 2.3), [Pt($y$nm)/Fe(0.9nm)] (y=0.9 and 2.3), were fabricated by the R.F. sputtering method. Crystal structure and multilayered structure were confirmed by θ-2θ X-ray diffraction measurements with the Cu-Kα1 radiation. Texture of (111) of fcc Pt and/or fcc Fe was observed in the each multilayers. Satellite peaks were observed near the fcc (111) diffraction peak. These satellite peaks were consistent with designed multilayer periods.

MCP's were measured at the AR-NE1A1 beamline of KEK-PF.

Results and Discussion

Figures 1 show contributions from interface Fe atoms and internal Fe atoms. Contributions from Pt atoms are also shown. The internal Fe atoms, the internal Pt atoms and the interface Fe atoms have anisotropic momentum spin density. However the interface Pt atom has isotropic nature. These facts suggest that the PMA of the Fe/Pt multilayer comes from the internal Fe atoms, the internal Pt atoms and the interface Fe atoms, but not the interface Pt atoms. From comparison with band calculations [4], it is suggested that the electronic structure of the internal Fe atoms and the interface Fe atoms can be explained by fcc Fe and Fe-Pt alloy, respectively, in the region of pz>1 a.u.

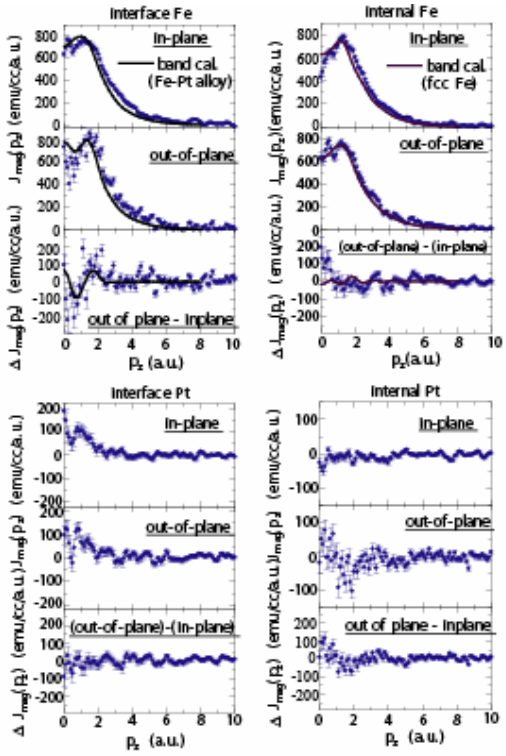

Fig.1 MCPs of internal atoms and interface atoms. Solid lines denote band calculations.

References

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