<포스터 2>

RDF Analysis of Tb-Fe Alloy Thin Films by Energy-Filtered Electron Diffraction

Se Ahn Song* and D.J.H. Cockayne#

*Samsung Advanced Institute of Technology, Suwon 440-600, Korea

#Electron Microscope Unit, The University of Sydney, N.S.W. 2006, Australia

INTRODUCTION

Thin films of amorphous rare-earth - transition metal (RE-TM) alloy can be prepared with uniaxial magnetic anisotropy, which can be exploited for bubble domain memory devices [1]. These materials are now commercially used as magneto-optic recording media which can store/rewrite 650 Mb in a single 5.25" disk. The magneto-optic technology was reviewed elsewhere [2] and this MO device is becoming popular for databases, document filing. image processing works, etc.. In this study we investigated the short-range ordering of Tb-Fe alloy thin films by on-line diffraction analysis.

MATERIALS AND METHODS

Tb-Fe alloy films (Tb: 0, 5, 15, 22, 27, 100 at.%) were prepared by DC magnetron co-sputtering with thickness of 150 - 300 Å. Both sides of the Tb-Fe films were overcoated with amorphous Si_3N_4 thin films (100 Å thick each) by reactive gas sputtering in the sputter before exposure to air atmosphere to avoid oxidation. These film thicknesses can satisfy the single electron scattering approximation [3] for processing of experimentally collected data. Energy-filtered electron diffraction patterns from these Tb-Fe films were

collected at 300 kV (Philips EM430) with PEELS and the data were processed to reduced intensity function ϕ (s) and finally to reduced density function G(r) using established algorithms [4,5].

RESULTS AND DISCUSSIONS

Some investigations on the short-range ordering of RE-TM alloy films were already carried out by X-ray method ($Tb_{21}Fe_{79}$ [6], $Gd_{20}Co_{80}$ [7]) and by off-line electron diffraction analysis [8]. Our work is similar in composition of alloys to that of Tewes et al. [8] but is more elaborate with better resolution. The diffraction intensity of a-Si_3N_4 films were much weaker than those of Tb-Fe films, so it was almost negligible. The G(r)'s showed that Tb_5Fe_{95} film is partly disordered and HRTEM observation revealed that Fe nanocrystals were surrounded with amorphous Tb-Fe alloy phase. The G(r) of $Tb_{22}Fe_{78}$ which is a compensation composition showed well-resolved 1st Fe-Fe (2.54 Å), 2nd Fe-Fe (2.88 Å) and Fe-Tb (3.10 Å) pair distances in the amorphous state. The whole G(r)'s represented that there is no Tb-Tb pair ordering in the Tb-Fe alloys. The G(r) of overcoated a-Si_3N_4 film showed that the average bond distances are 1.69 Å for Si-N and 2.95 Å for N-N.

REFERENCES

1. Cambino RJ et al, AIP Conf Pro 18 (1973), 578-592.
2. Kryder MH, J Appl Phys 57 (1) (1985), 3913-3918.
3. Anstis GR et al, Ultramicroscopy 26 (1988), 65-70.
4. Cockayne DJH and McKenzie DR, Acta Cryst A44 (1988), 870-878.
5. Cockayne DJH et al, Micros Microanal Microstruc 2 (1991), 1-9.
6. Fukuda K et al, Jap J Appl Phys 25 (11) (1986), 1640-1643.
7. Maksymowicz LJ et al, J Magnetism Mag Materials 35 (1983), 281-282.
8. Tewes M et al, Proc XIIth Int Cong Electr Micros Vol 4 (1990), 120-121.