DIFFUSION OF Ta AND Bi IN FePt THIN FILMS STUDIED BY GRAZING-INCIDENCE X-RAY FLUORESCENCE

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Grazing Incidence X-Ray Fluorescence (GI-XRF) related to X-Ray Total Reflection is a valuable technique for elemental depth profile and microstructure characterization of thin films and multilayers. GI-XRF analysis equipment has been designed and constructed in the Lab of Nuclear Analysis Techniques (LNAT) at the Institute of High Energy Physics (IHEP), CAS. Its performance had been evaluated using GaAs and Ge wafers as standard reference materials, and showed good repeatability and stability.

$L1_0$ ordered FePt alloy is one of the most promising materials for ultrahigh density magnetic recording media. Two series of FePt films are prepared, one is Si(substrate)\Ta\FePt\C with different thickness Ta buffer layers and the other is Si(substrate)\Ta\Bi\FePt\C with different thickness Bi insert layers. Both kinds of layers are used to improve the microstructure and magnetic properties of the films. On the base of magnetic properties tests, and combined with the X-Ray Reflectivity (XRR) analysis, GI-XRF is successfully applied to elemental depth profile investigation and microstructure characterization of the FePt thin films in different annealing states. The results indicate that the changes of magnetic properties are closely related to microstructure changes of the films. During the lower temperature annealing process, Ta or Bi atoms in polycrystalline state diffuse into FePt films and so a relatively higher concentration region of Ta or Bi atoms comes into being near the upper interface of FePt layers. During the subsequent annealing, Ta atoms in the thinner buffer layers diffuse continuously into FePt layers, and Bi layers are even overturned to the upper interface of FePt layers. The diffusion process of Ta or Bi atoms into FePt layers will promote the formation of $L1_0$ FePt ordering phase and improve the magnetic properties, but the quantity of the impurity atoms such as Ta or Bi in FePt layers should be controlled below a proper rate.