MAGNETO-OPTICAL SPECTROSCOPY AND SPECTROSCOPIC ELLIPSOMETRY OF $Co_{60}Fe_{20}B_{20}$ THIN FILMS

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With the increasing interest in CoFeB for the realization of spintronic devices, the magneto-optical and optical transitions in spin-polarized electronic states are of significant importance for the characterization of such devices and further understanding of spin-dependent phenomena. We present the characterization of $Co_{60}Fe_{20}B_{20}$ thin films with combined magneto-optical Kerr effect (MOKE) spectroscopy and spectroscopic ellipsometry (SE).

$Co_{60}Fe_{20}B_{20}$ films with thicknesses ranging from 5 nm to 20 nm and a 3 nm Au capping layer were prepared by magnetron sputtering on glass and on thermally oxidized Si substrates. After a full characterization of the as-deposited samples, these were annealed in vacuum at 350ºC in order to study the changes in the magneto-optical and optical spectra of the samples upon the crystallization of CoFeB.

Variable angle spectroscopic ellipsometry (VASE) measurements were performed in the spectral range from 0.73 eV to 5 eV, in transmission and reflection modes, the latter including measurements at five angles of incidence (Φ = 50º, 55º, 60º, 65º and 70º). This allowed the relevant optical constants and the diagonal component of the dielectric tensor to be derived for CoFeB. The spectral dependence of the dielectric tensor component and the absorption coefficient were deduced from the experimental data for the samples prior and after annealing of CoFeB thin films, allowing further assessing the changes in the spectra due to the crystallization of the layer.

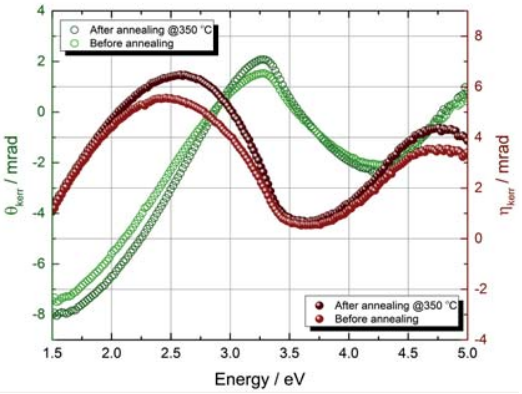

Figure 1: MOKE spectra measured at RT for $Si/SiO_2(100nm)/Co_{60}F_{20}eB_{20}(20nm)/Au(3nm)$ before and after annealing the sample at 350 °C. The hollow circles show the real part (rotation) and solid sphere are the imaginary part (ellipticity) of the polar MOKE spectra.

The MOKE investigations were performed in polar geometry in the spectral range of 1.5 eV to 5.0 eV, under magnetic saturation conditions. The Kerr rotation angle (θ_{Kerr}) and the Kerr ellipticity (η_{Kerr}) were measured as a function of the photon energy for the samples before and after annealing. The features of the θ_{Kerr} and η_{Kerr}–spectra at ~3.25 eV and ~2.5 eV are observed to become narrower after annealing, these spectral features are directly related to the magneto-optical transitions between the spin-polarized electronic states and the narrowing can be ascribed to the crystallization of CoFeB.

Finally, the present study provides access to the magneto-optical and optical characteristics of CoFeB thin films which can be determinant for spintronic device applications.

Keyword—CoFeB, Magneto-Optics, Ellipsometry, and Spintronic.