Preparation of $Bi_2YFe_5O_{12}$ and $BiGd_2Fe_5O_{12}$ magnetic garnet thin films by Metal Organic Decomposition method on GGG and glass substrate

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Spatial light modulator (SLM) is a real-time programmable device for modifying amplitude, phase or polarization of optical wavefront by electrically controlled signals. Application of magneto-optic SLM (MOSLM) is highly expected because of their extremely fast pixel switching speed and non-volatile property. A single crystal garnet with perpendicular magnetic anisotropy and two polarizers have been used as a pixel element to switch the optical output depending on the up and down magnetization owing to Faraday Effect [1]. Magnetic garnet films with high Faraday rotation and efficient magnetization reversal are required for various applications in the visible and near infrared spectral regions.

We prepared and characterized the Bi:YIG ($Bi_2YFe_5O_{12}$) and Bi:GdIG ($BiGd_2Fe_5O_{12}$) films by metal organic decomposition (MOD) method on (111) gadolinium gallium garnet (GGG) and glass substrate in different annealing temperature of 620 – 800 °C under dry air, in order to investigate the relationship among the Faraday effect, magnetic anisotropy, and fabrication condition, because fabrication condition determines the film composition, crystal structure and magnetic anisotropy. The thin films prepared in this study were investigated by Faraday effect and X-ray diffraction (XRD). Fig. 1 shows the Faraday rotation spectra of the Bi:YIG and Bi:GdIG thin films. Fig. 2 shows the magnetic field dependence of the Faraday rotation (normalized) for these samples. Fig. 3 shows XRD patterns of these films showing no other peaks associated with polycrystalline or impurity phases. With increasing the annealing temperature, XRD intensity from the thin films increased, and Faraday rotation increased, showing that the amount of Fe^{3+} associated to the magnetic garnet crystal increased. Furthermore, the magnetic anisotropy of samples is changed from in plane to perpendicular direction by increasing the annealing temperature. A possible reason for the change of magnetic anisotropy are the difference of chemical composition (O_2 deficiency) of Bi:YIG and Bi:GdIG thin films by increase of annealing temperature. The other reason is that the strain from the GGG substrate is decreased as shown in Fig. 3, leading to perpendicular magnetic anisotropy [2-3].

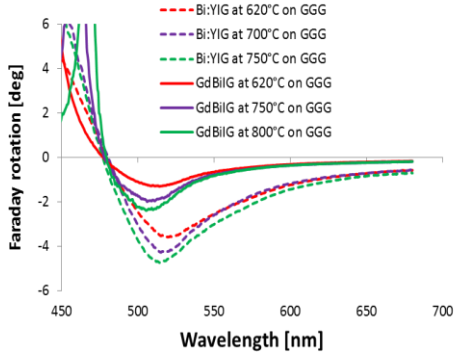

Figure.1. Faraday rotation spectra of Bi:YIG and Bi:GdIG films on GGG substrates

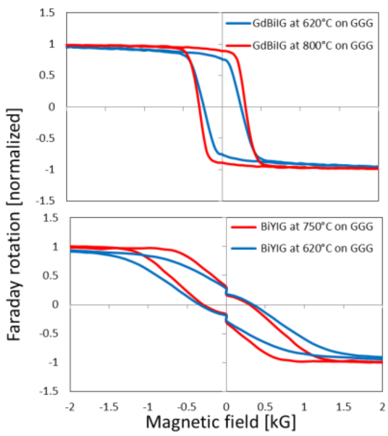

Figure.2 magnetic field dependence of normalized Faraday rotation at the wavelength of 600 nm

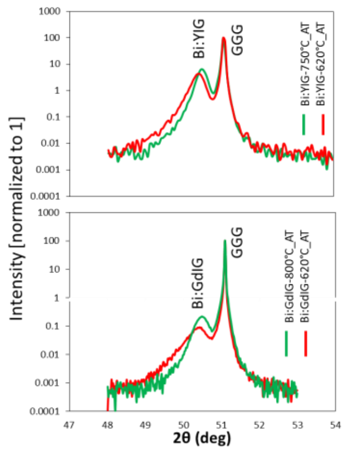

Figure.3 XRD pattern of Bi:YIG and Bi:GdIG on GGG substrate

Reference

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