THIN FILMS MAGNETO-OPTIC CHARACTERIZATION WITH SUPERCONTINUUM TUNABLE SOURCE

Photon etc
A spectrum of solutions

INTRODUCTION

Magneto-optical (MO) effects are used either as tools for probing the magnetization reversal characteristics of a wide range of sample types, or as an effective way to modify the polarization of light via induced magnetization state in samples. In transparent samples, the Faraday effect (rotation of the polarization of light proportional to the magnetic induction field and optical path in the medium) can be used to elaborate Faraday rotators, a key element in the design of optical isolators (1). Along with other MO effects such as Kerr measurements, they provide a non-destructive probe for in-situ measurements of samples, such as thin films.

EXPERIMENTAL DETAIL

Spectral dependence of the Faraday MO effect in the visible part of the electromagnetic spectrum along with temperature dependence measurements were performed on a semiconductor 2 microns epilayer (GaP) grown with embedded metallic ferromagnetic nano-clusters (MnP). The confined geometry of the experiment, which necessitates a cryostat chamber with optical window placed within the pole gap of an electromagnet applying the DC magnetic field parallel to the normal of the sample, made it difficult to use a monochromatic light beam produced by filtering an incandescent light source with a standard monochromator. Instead, we use a collimated tunable laser based on a Leukos (SP20) supercontinuum source and Photon etc's Tunable Laser Line Filter. Figure 1 shows the experimental setup used to investigate the MO properties of the GaP:MnP in the Faraday configuration. The analyzer is mounted on a motorized rotation stage to allow tracking of the extinction condition as a function of temperature, wavelength and applied magnetic field. Hysteresis curves were obtained by rotating the analyzer at 45 degrees with respect to the polarizer and sweeping the magnetic field from -400 to 400 mT. Small angles of rotation ensure linear variation in transmitted intensity as a function of the rotation angle of the polarization, or applied magnetic field. The source of the electromagnet, the temperature controller for the cryostat, the angular position of the analyzer and the wavelength selection of the laser output (via Photon etc Tunable Laser Line Filter) are all computer controlled. The angle of rotation must be obtained independently for each applied field, wavelength and temperature.

RESULTS

The total Faraday rotation of the epilayer as a function of wavelength at a temperature of 220K is displayed in figure 2. The free carriers contribution of the GaP substrate has been carefully substracted. The GaP:MnP epilayer produces a maximum MO effect in the near infrared whereas the substrate has a monotonic decrease in the MO effect as the wavelength is increased. The inset shows the Faraday rotation hysteresis curves at 210K, 270K and 290K at 655 nm. The giant Faraday rotation in these systems has been reported in (2). The tunable laser allowed us to investigate the hysteresis signature of the MO Faraday effect at different wavelengths as well as different temperatures within the limited work space of the apparatus.

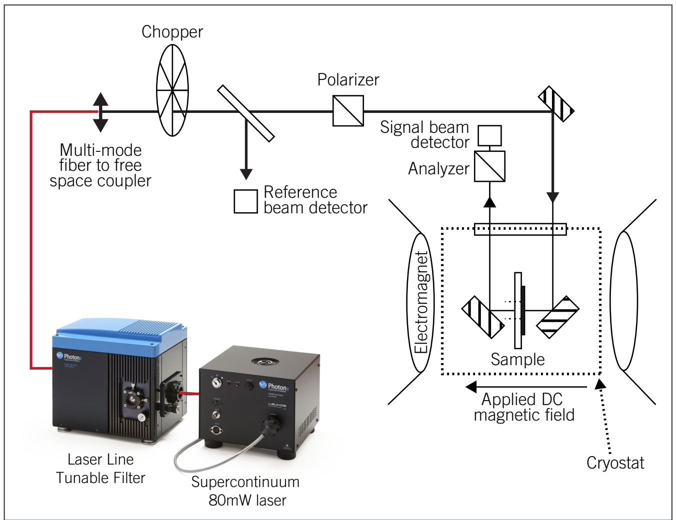

FIGURE 1 : EXPERIMENTAL SETUP

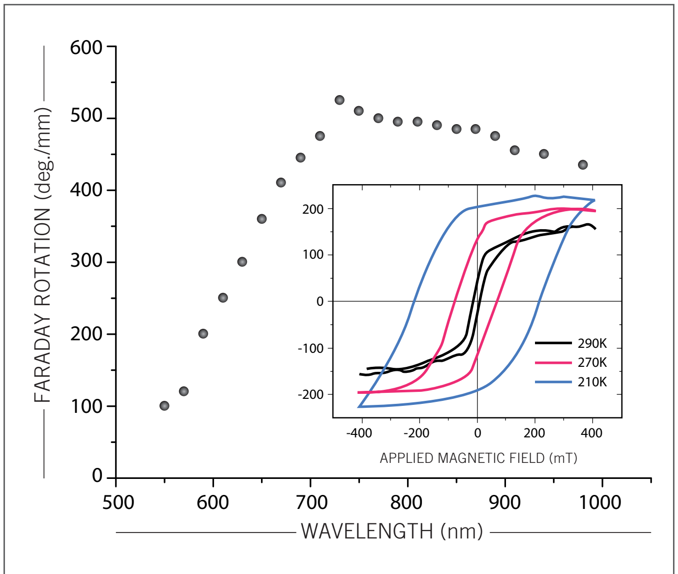

FIGURE 2 : FARADAY ROTATION VS WAVELENGTH

REFERENCES

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