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Analytic expressions of the general magneto-optical Kerr effects for a nanometer-thick magnetic layer with a capping layer

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One of the popular methods for probing magnetism in various magnetic nanostructure is to utilize magneto-optical Kerr effect (MOKE), because the MOKE signal is directly proportional to the magnetization for a given material with a sub-monolayer sensitivity. The MOKE is well understood with matrix method for the bulk and multilayer systems for arbitrary magnetization directions and an oblique incident beam geometry[1]. Simplified analytic formulae were also derived for optically thick and ultrathin magnetic layers, and those analytic formulae gave more physical insights of MOKE[2]. Those formulae are very useful for many experimental situations, however they are not applicable to more common situations such as a system having a capping layer. Recently, we have derived the first-order analytic expressions for the general MOKE for a magnetic layer covered by an optically thin capping layer and the first-order approximated analytic expressions for the general MOKE for *a nanometer-thick magnetic layer covered by a thin capping layer* is reported[3]. In common ex-situ experimental situations, a few nanometer–thick magnetic layer was deposited and followed by a thin capping layer to prevent unwanted oxidation. In that case, a complex matrix method must be employed to analyze MOKE data. However, such matrix method requires enormous numerical work, furthermore, it does not give any physical insight. Since a typical thickness of the magnetic and capping layers is an order of a few nanometer, we could take first-order approximation for both layer thickness in the visible wavelength range which we are interested in. The approximated analytic expressions are developed for the most general situation of an arbitrary magnetization direction and an oblique incident beam of either *p*- or *s*-wave. The validity of the approximated expressions was confirmed via exact numerical solutions, and it was found that the estimated error was only a few percent for an optically thin capping layer.

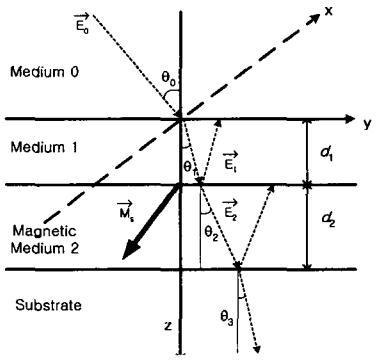

Fig. 1 The coordinate system.

References

[1] J. Zak, E. R. Moog, C. Liu, and S. D. Bader, J. Magn. Magn. Mater. **89**, 107 (1990).
[2] C.-Y. You and S.-C. Shin, J. Appl. Phys. **84**, 541 (1998).
[3] C.-Y. You and S.-C. Shin, submitted to Appl. Phys. Lett.