

Fabrication of nano-structured magnetophotonic crystals with high spatial dimensions and their spin-dependent linear and non-linear optical functions

Mitsuteru Inoue

(Toyohashi University of Technology, School of Engineering, Professor)

【Outline of survey】

We have developed the magnetophotonic crystals (MPCs) having nano-scaled periodic structures with transparent magnetic materials as an independent study in the field of magnetism and optics, although photonic crystals have been studied in the field of optics. Since one-dimensional MPC has huge magneto-optical effect, we showed that this new optical medium has a possibility to control its optical properties by controlling the spins in the magnetic materials. This study aims to develop fabrication methods of artificial nano-scaled structures in two- and three-dimensions, and to reveal their spin-dependent linear and nonlinear optical properties. As the results, we develop new optical materials that can be controlled by the spin; in addition, we investigate their fundamental properties for applications like micro magneto-optical devices. The research on the MPCs started from our theoretical study in 1997. At present, many researchers in Japan and other countries have joined to this research field. In consequence, a new session for the MPCs has been held on the 2005 International Symposium on Materials (MRS) in USA. The study of the MPCs is extremely new and original, because magnetic and magneto-optical properties will be investigated widely and deeply for newly developed magneto-optical nano structures.

【Expected results】

The MPCs are expected to have unique properties that have never been observed in the conventional photonic crystals based on dielectric materials. Furthermore, the MPCs, which are thought to be new-type of photonic crystals with broken time-symmetry, have large potential. Therefore, it is expected that the results obtained by this study would produce new research field for optical materials. In addition, the study is also of importance in academic research because new concept using an interaction with photon will add into the nano-scaled magnetism. On the other hand, one-dimensional MPCs have already found their potential applications in optical isolators and spatial light modulators. New industrial fields would be produced since joint businesses with companies have already been started.

【References by the principal researcher】

- M. Inoue, "Magnetophotonic crystals," MRS. Proc., Symp. Magneto-optical materials for photonics and recording (2005) in press.
- A. B. Khanikaev, A. V. Baryshev, M. Inoue and A. B. Granovsky, " Soluble two-dimensional model of a magnetophotonic crystal, " Phys. Rev. B, (2005) in press.
- O. A. Aktsipetrov, T. V. Dolgova, A. A. Fedyanin, T. V. Murzina, M. Inoue, K. Nishimura and H. Uchida, " Magnetization-induced second- and third-harmonic generation in magnetophotonic crystals, " J. Opt. Soc. Am B, vol.22, No.1, pp.176-186 (2005).

【Term of project】 FY 2005 - 2009

【Budget allocation】 86,200,000 yen

【Homepage address】 <http://www.maglab.eee.tut.ac.jp/>