【Grant-in-Aid for Scientific Research (S)】
Science and Engineering (Engineering)

Title of Project : Artificial Magnetic Lattices with Introducing Nanoscale Structures and its Engineering Applications

Mitsuteru Inoue
(Toyohashi University of Technology, Graduate School of Engineering, Professor)

Research Project Number : 26220902 Researcher Number : 90159997
Research Area : Engineering, Electronic and Electrical Materials Engineering
Keyword : Artificial magnetic lattice, Magnetics, Ferroelectrics, Optics

【Purpose and Background of the Research】

Research fields engineering of magnetic media with nanoscale artificial structures are becoming important technology because of their unique and interesting properties which are not observed in bulk situations. In particular, interactions among light, spin waves, high frequency electromagnetic waves, and nanoscale structures have attracted interests because of the recent rapid development of the information communication technology. For instance, the photonic crystals generating photonic band gap, localization of light and so on have been studied well.

Different from these studies, magnetophotonic crystals comprising transparent ferromagnetic medium with nanoscale structures have been investigated, showing huge enhancement of magnetooptical responses. Such interaction is not only observed between optical wave and nanoscale spin system but also between any wave and wavelength-scale system. From this point of view, we investigated the fundamental properties of spin waves propagating in periodic spin systems, exhibiting magnonic band gap (stop band for spin waves) in GHz region.

These structures, namely artificial magnetic lattices, are significantly fascinating techniques not only in the field of physics but also engineering.

In this study, fundamental properties and design rules of artificial magnetic lattices controlling photons, spin waves, and magnetoelastic waves would be experimentally and theoretically revealed.

【Research Methods】

First of all, as an analogy of the magnetophotonic crystals, we are going to introduce the nanoscale structures into one- two- three dimensional magnonic crystals modulating the flow of spin waves (magnons). These results can be applied to the noble information device systems required in the brain science and bio medical fields.

There are many fundamental tasks to achieve the nanoscale magnonic crystals. Therefore, in this study, (1) fabrication conditions of nanoscale magnonic crystals will be determined. Then, thin single crystalline garnet film will be grown and applied to the magnonic crystal formation. (2) Nanoscale magnonic crystals will be applied to the high sensitive magnonic field sensors. (3) Three dimensional display using magnetic hologram, and three dimensional data memory will be fabricated.

【Expected Research Achievements and Scientific Significance】

This study is going to conclude the behavior of the artificial magnetic lattices including magnetophotonic crystals and magnonic crystals, and develop the exceptional field which cannot be achieved in the world. And also, the novel information procession devices and systems are going to be substantialized.

【Publications Relevant to the Project】

・M. Inoue, R. Fujikawa, A. V. Baryshev, A. Khanikaev, P. B. Lim, H. Uchida, O. Aktsipetrov, A. Fedyanin, T. Murzina, and A. Granovsky, "Magnetophotonic crystals," J. Phys. D: Appl. Phys. **39**, R151-R161 (2006).
・M. Inoue, A. V. Baryshev, and M. Levy, "Magnetophotonics" (Springer, New York, 2013).

【Term of Project】

FY2014-2018

【Budget Allocation】

147,000 Thousand Yen

【Homepage Address and Other Contact Information】

http://www.spin.ee.tut.ac.jp/