Optical and Magneto-optical properties of three-dimensional magnetophotonic crystals

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Magnetophotonic crystals (MPCs) [1, 2], composite materials in which magnetic materials are implanted into the dielectric lattice, have attracted major interest, because the control of the electromagnetic wave by MPC structure is expected to be a key technology for future applications in optoelectronics. Three-dimensional MPCs are of interest because they give a possibility for three-dimensional light control. Due to their magneto-optical properties the Faraday and Kerr effects in photonic band gap are expected to be much stronger, therefore three-dimensional MPCs could be much effective than existing devices.
Today, there are a few kinds of three-dimensional photonic crystals which can be used for preparation of MPCs: synthetic opals, inverted opals and colloidal crystals. In present work we utilized high-quality opal photonic crystals for the visible as a matrix for impregnating with magnetic material. Characterization of these samples with atomic-force microscopy and the study of their optical properties was described in ref. [3]. Opal-garnet and opal-ferrite spinel three-dimensional MPCs were prepared through sol-gel pyrolysis. We studied an influence of quantity of magnetic materials inside of opal samples on magneto-optical properties of MPCs synthesized. It was shown that increasing of magnetic component volume leads to decreasing of transparency of MPCs, whereas the coercitivity is rising. The Faraday rotation outside the stop gaps has the behavior of magnetic component. We found the considerable changes of the Faraday rotation angle in photonic band gap of MPCs in comparison to bulk magnetic material implanted.

References

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