Enhancement of magnetooptical effects in photonic crystals

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Periodic dielectric media, or photonic crystals (PhC), are promising structures for controlling the propagation of electromagnetic radiation. PhC's can be used to study a wide range of physical problems related to the light localization and light emission. PhC materials with photonic band gaps permit the fabrication of micro-cavity lasers, single mode light emitting diodes, highly efficient wave guides. Prominent properties of PhC's offer the opportunity to create efficient dispersion compensation, enhanced nonlinear frequency conversion, novel superprism devices and so on.

With respect to applications to optical devices, it is advantageous to obtain the tunability in PhC's. Apart from the other ways, PhC's tunability can be obtained by means of the application of external magnetic or electric fields. These two methods are of great interest because they not only permit significant tunability but also can lead to some new interesting phenomena of magnetooptics and electrooptics which are essential for the novel read out devices and some devices of integrated optics.

In this work, we study theoretically magnetooptical and electroooptical properties of two dimensional PhC's composed of dielectric (SiO_2), electrooptical (KDP, GaAs) or magnetic (YIG) materials.

One of the main features of the PhC's optics is the enhancement of the circular and linear birefringence that takes place in the vicinity of the Brillouin zone's critical points (Γ, X, Z points, *et. al.*). This enhancement is in compliance with fundamental property of PhC's: near extremum points of the Brillouin zone critical deceleration of radiation takes place that leads to the increase of the interaction time between radiational mode and the matter system and, thus, magnetooptical and electrooptical effects rise steeply.

While our theoretical investigations it was also shown that in some geometries of the observation TE-TM mode conversion comes about – the effect similar to the magnetooptical Faraday effect.

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References

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