Magnetic-Field Dependence of Effective Plasma Frequency for a Plasma Photonic Crystal

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Abstract

The effective plasma frequency in a photonic crystal (PC) is defined as the lowest frequency at which electromagnetic wave can start to propagate through the PC. In this paper, we theoretically investigate the effective plasma frequency fp;eff for a magnetized 1-D plasma PC (PPC). The PPC is made of two constituents, i.e., the plasma and the dielectric material like quartz. The effective plasma frequency in a PPC is obtained based on the calculated photonic band structure (PBS). It is found that fp;eff can be controlled by the externally applied static magnetic field, namely, fp;eff decreases significantly as the static magnetic field increases. This suggests that the plasma layer in a PPC shows a dielectriclike behavior when the magnetic field is applied. In addition, in the presence of static magnetic field, fp;eff will be increased as a function of electron density and thickness of the plasma layer. In the angular dependence of effective plasma frequency, we find that fp;eff is a decreasing function of angle of incidence in the absence of the static magnetic field. However, it becomes an increasing function of angle of incidence when the static magnetic field is applied. Finally, the effect of filling factor of the plasma

layer is also illustrated.

Keyword：Photonic crystal