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The characteristics of PBGs in 1-D plasma photonic crystals

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Abstract

In this report, the transmission characteristics of both TM and TE wave in a one-dimensional (1-D) plasma photonic crystal (PPC) consists of periodically alternating layers of quartz discharge tubes and air are studied. It is found that, for TM wave, a bandgap within a fixed frequency band arise from the quartz tube array can be closed in the existence of the plasma with an appropriate plasma density and can be reopened as the increase in the plasma density. In addition, the unique opening-and-closing behavior of the PBG also depends on the collision frequency of the plasma, and a high enough collision frequency can reopen it.[1] On the other hand, for TE wave, the complex behaviors of the PBG at a frequency band lower than plasma frequency are strongly related to whether the surface lattice resonance (SLR) occurs or not, in which the localized surface plasmon resonance ω_{LSPR} and Bragg resonance ω_l play an important role. [2] The condition for the generation of 1-order SLR is described as $\omega_{LSPR}=\omega_l$, which is verified by simulation These studies pave the way for realizing tunable bandgaps in microwave applications.

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