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A Comparative Study of a Defective Superconductor/ Semiconductor-Dielectric Photonic Crystal

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Abstract : Temperature-dependent tunable photonic crystals have attracted widespread interest in recent years. In this research, transmission characteristics of a one-dimensional photonic crystal structure with a single defect have been studied. Here, we assume two different defect layers: InSb as a semiconducting layer and HgBa₂Ca₂Cu₃O₁₀ as a high-temperature superconducting layer. Both the defect layers have temperature-dependent refractive indexes. Two different types of dielectric materials (Si as a high-refractive index dielectric and MgF₂ as a low-refractive index dielectric) are used to construct the asymmetric structures (Si/MgF₂)^NInSb(Si/MgF₂)^N named S.I, and (Si/MgF₂)^NHgBa₂Ca₂Cu₃O₁₀(Si/MgF₂)^N named S.II. It is found that in response to the temperature changes, transmission peaks within the photonic band gap of the S.II structure, in contrast to S.I, show a small wavelength shift. Furthermore, the results show that under the same conditions, S.I structure generates an extra defect mode in the transmission spectra. Besides high efficiency transmission property of S.II structure, it can be concluded that the semiconductor-dielectric photonic crystals are more sensitive to temperature variation than superconductor types.

Keywords : defect modes, photonic crystals, semiconductor, superconductor, transmission
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