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Title

Thermally tunable and omnidirectional terahertz photonic bandgap in the one-dimensional photonic crystals containing semiconductor InSb

Source

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Abstract

Thermally tunable and omnidirectional terahertz (THz) photonic bandgaps in the one-dimensional photonic crystals composed of alternating layers of semiconductor material InSb and dielectric material SiO_2 are studied theoretically. This photonic bandgap is strongly dependent on the lattice constants and the thickness ratio of the constituent InSb and SiO_2 layers. It is found that the lower-order gap is invariant on the lattice constants, but the higher-order gaps are all sensitive to the lattice constants. Moreover, the band-edges of the higher-order gaps shift to lower frequency as the increasing thickness ratio. Additionally, the Gap II is also angle-independent, and the omnidirectional bandgap can occur in the terahertz range. Omnidirectional bandwidth for both polarizations is about 1.5 THz at 220 K. Most important of all, the omnidirectional bandgap can be tuned by controlling the external temperature, which results from the dependence of the semiconductor plasma frequency on the temperature. As the temperature increases, the upper and lower frequency limits of the Gap II shift to higher frequency and the bandwidth becomes narrow. (36 References).