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Clear Influences of Temperature on Phoninic Band Gaps

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Figure 1

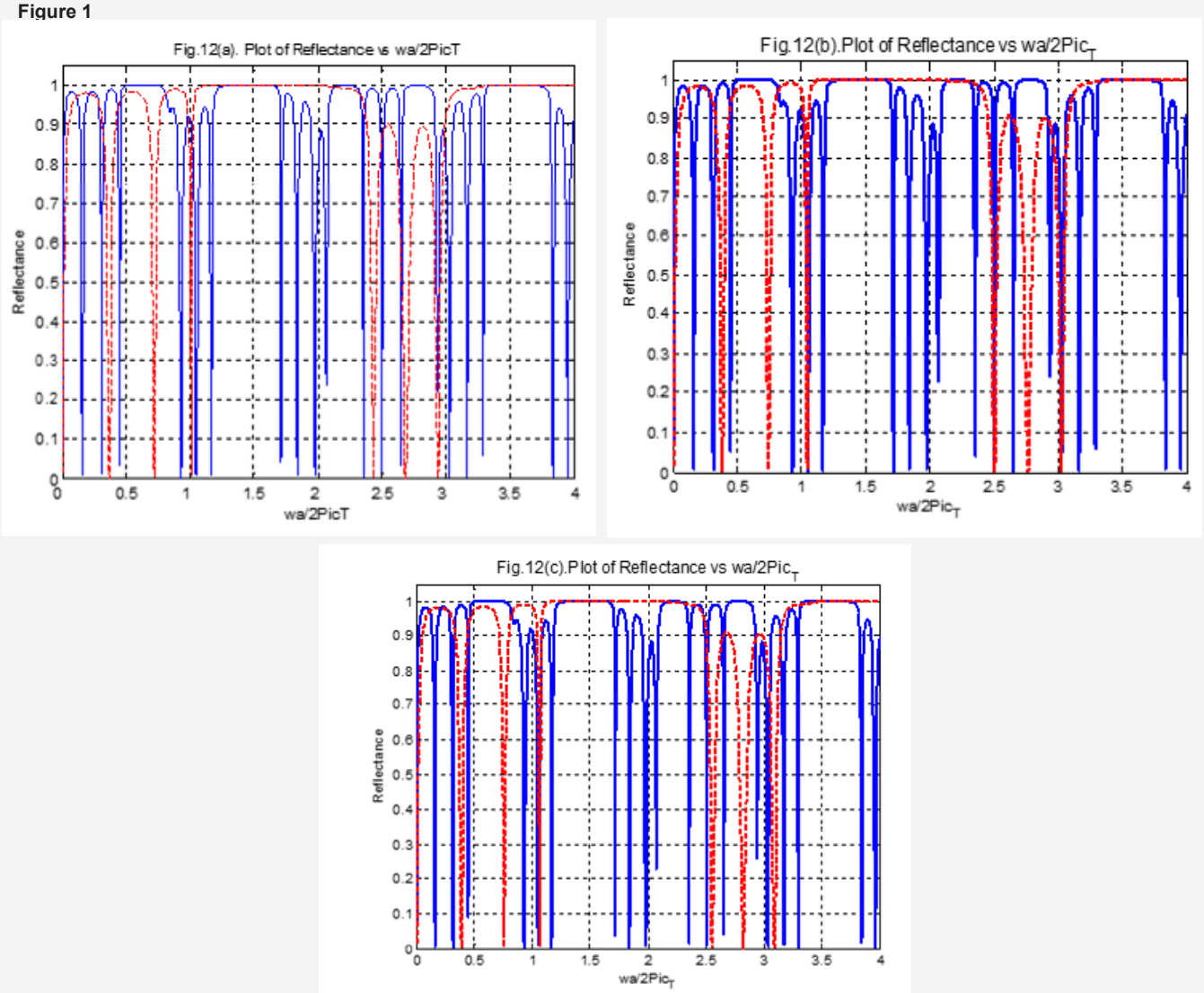

Figure 1: A plot of reflectance R versus $\omega a / 2\pi c_T$ for S- waves (blue lines) and P- wave (Red lines) propagate normally on a 1D perfect PnC structure consist of four unit cells (eight layers), each unit cell consists of aluminum and gold materials. Different temperatures are considered: (a) T = 250C, (b) T =2800C, and (c) T =7100C.

The influences of temperature on the band gap structure can appear more clearly in the case PnCs with high melting point materials as shown in Figure 1. Aluminum/gold PnCs experiences significant effect by increasing temperature change. From these results, several factors related to temperature will be change. For instance, the thermal conduction in silicon PnCs [1-3] can be change according to these results, where the dispersion relations depend on the frequency band gap values. Also the thermal conductivity of the PnC structure can be change depend on the generated localized modes within the band gap. Since the thermal conductivity of any structure is represented by the temperature gradient at which the heat is absorbed or lost. Therefore, the localized states within the band gaps will directly change the temperature gradient, in turn, will change the whole thermal conductivity of the PnC structure. The elastic constants are related to the isothermal constants by the formula [1-3] (Figure 1),

$$\lambda^{\sigma} = \lambda^{\theta} + \frac{9\beta^2 B^2 \theta}{\rho C_v}, \qquad \mu^{\sigma} = \mu^{\theta}, \tag{1}$$

where the superscripts σ and θ indicate adiabatic and isothermal constants, β the thermal expansion coefficient, B the bulk modulus $(B = \lambda + 2/3\mu)$, θ the absolute temperature in kelvins, ρ the density, and C_v the specific heat at constant volume. Eq.24 indicates that there is a difference between λ^{σ} and λ^{θ} should be taken into account.

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Conflicf of Interest

No conflict of interest.

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