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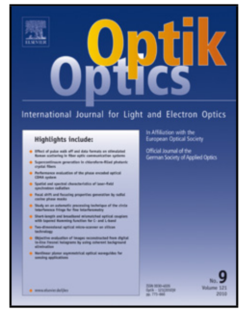

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The Effect of Dissipation on Defect Modes in a One-Dimensional Photonic Crystal

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Abstract

Photonic crystals are artificial structures with periodic dielectric properties, which are divided into one-dimensional, two-dimensional, and three-dimensional crystals .In this study, electromagnetic wave propagation was studied in a one-dimensional photonic crystal. To understand wave propagation in a one-dimensional photonic crystal, which is a multi-layered system, reflection and transmission of TE and TM waves in a thin film, and finally in a multi-layer system was investigated by using the transfer matrix method. Transmission spectrum of symmetric and asymmetric ($(Si / Si0_2)^N D (Si0_2/ Si)^N$ and $(Si / Si0_2)^N D (Si / Si0_2)^N$) crystal with defect layers (D) PbSe, $Pb_{1-x}Sn_xTe$ and Hg_xCd_xTe was depicted in frequency range of 4-7 terahertz and a defect mode was observed in band gap. Because these three materials had a complex refractive index, they rendered dissipation and reduced the amount of transmission in the system .Then, temperature dependence behavior of defect modes was studied. The results indicated that with increasing temperature, the height of defect mode decreases. As the temperature rose, decrement of defect mode height in photonic crystal with a Pb_xSn_xTe defect became much more than two others. Finally, Plots of electrical permittivity was plotted in terms of frequency and temperature for three materials. Only real part of electrical permittivity of $Pb_{1-x}Sn_xTe$ remained constant with frequency changing .Also, in all cases, with increasing temperature, amplitude of real part of electrical permittivity decreased and imaginary part increased.

Keywords: photonic crystal, one-dimensional dielectric photonic crystal, defect layer, defect mode, constant and dissipation

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