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Topic of the Thesis: "STUDY OF SECOND- AND THIRD- ORDER NONLINEAR INTERACTIONS INSIDE PHOTONIC CRYSTALS"

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Abstract

Present study is an understanding of the interplay between the material and the structural parameters of one dimensional photonic crystal (1D PC) structures. Over the last couple of decades, nonlinear photonic crystals (NPCs) have been vastly studied for understanding the nature of light-matter interaction occurring inside them. Various types of second- and third-order nonlinear interactions have been studied in photonic crystal structures. This thesis is an attempt to understand the effects of nonlinear interactions inside photonic crystals via numerical analysis, design and simulation. Numerical studies make use of the advantages of photonic crystal technology by predicting novel devices and helping us to understand their behavior in realistic conditions. Hence, improvement in the existing numerical techniques as well as development of novel ones is an important criterion in the growth of photonic crystal technology.

The first chapter introduces the subjects, gives background material and a brief description of the work to be undertaken. The theoretical work presented in the thesis is mainly based on the search for constituent materials with higher value of $\chi^{(2)}$ and $\chi^{(3)}$ nonlinear coefficients being

on ongoing process for nonlinear photonic crystals with their possible use as active structure in optical device designing.

Chapter 2 of this thesis discusses propagation of electromagnetic waves through a layered structure, dispersion in one-dimensional periodic structures. The numerical results obtained have been presented in the form of transmission curves for samples CdS-SiO_2, ZnSe-SiO_2, ZnS-SiO_2 chosen. Response of these photonic structures have been presented and compared.

Chapter 3 deals with Second-Harmonic Generation in such one dimensional photonic crystals (1DPC). Nonlinear propagation of Lorentzian and Gaussian pulses in 1DPC have been discussed. Results for SHG in the chosen crystals and comparative conversion efficiency for both types of pulses have been described.

Chapter 4 deals with seeded third-order nonlinear interactions in one-dimensional photonic crystals. Nonlinear propagation of signal pulse at fundamental field (FF) frequency in presence of strong pump pulse propagation of second harmonic field (SHF) frequency have been discussed. Numerical results obtained for effect of $\chi^{(3)}$interactions inside the three chosen photonic crystals have been obtained and presented.