一維光子晶體理論模擬與分析

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摘　　要

當兩種不同介電常數的材質在空間中成週期性的排列,則某些特定波長的光波或電磁波會被排斥，亦即在該頻率電磁波不能存在其間。材料的結構具備這種光子能隙的性質者，稱為光子晶體。

本論文利用有限差分時域法(Finite-Difference Time-Domain method)，發展了一個 C++程式來模擬光子晶體的各項特性。在一維的光子晶體分析中是有限週期的結構,可以使用有限差分時域法模擬有限空間之電磁波行為的特性。我們並利用有限差分時域法決定空間結構上的優勢，探討了具缺陷晶格之光子晶體的特性。利用這些特性，我們嘗試設計工作波長為 1.55μ之光學濾波器。

Analysis and Simulation of One-Dimensional Photonic Crystal

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Abstract

Materials with periodic dielectric structure give the property able to suppress or to allow the propagation of the electromagnetic waves in them for only some specific wavelengths. It means that light with specific wavelength can not propagate in such a material structure. Materials with this property are named as photonic crystal.

In this study, a C++ program is developed using Finite-Difference Time-Domain (FDTD) method to analysis and to simulate the wave properties in the photonic crystal. We can only fabricate a photonic crystal with the finite period structure, and this finite structure can be analyzed by the FDTD method such that the FDTD method can deal with the behavior of electromagnetic wave in finite space. Another advantage of the FDTD method is on the simulation of the defect structures, so we also discuss the defect modes of the photonic crystal with defect structure. We use the defect modes to design an optical filter for 1.55 μm wavelength.

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