

Simulation of 2D Photonic Crystal with COMSOL Multiphysics® Software

Z. Liang¹, Z. Meng², K. Jie¹, Y. Benxi¹

¹Institute of Optics and Electronics, Chinese Academy of Sciences, Chengdu, China

²Institute of Semiconductors, Chinese Academy of Sciences, Beijing, China

Abstract

This paper introduces the concept of the photonic crystal, the research methods and the application of photonic crystals. Starting from Maxwell's equations, the functional form of the TE mode and TM mode of the 2D crystal is derived. In 2D crystal, the functional form of TE mode is $F(\phi) = \iint_{\Omega} \{ 1/\epsilon(r) [(\partial\phi/\partial x)^2 + (\partial\phi/\partial y)^2] - 2ik \cdot 1/\epsilon(r) \phi \cdot [\partial\phi/\partial x + \partial\phi/\partial y] + [k^2 1/\epsilon(r) - ik \cdot \nabla 1/\epsilon(r) - (\omega/c)^2] \phi^2 \} d\Omega$ and the form of TM mode is $F(\phi) = \iint_{\Omega} \{ 1/\epsilon(r) [(\partial\phi/\partial x)^2 + (\partial\phi/\partial y)^2] - 2ik 1/\epsilon(r) \cdot \phi [\partial\phi/\partial x + \partial\phi/\partial y] + [k^2 1/\epsilon(r) - (\omega/c)^2] \phi^2 \} d\Omega$.

According to the functional forms, we conduct some stimulation about two-dimensional photonic crystal with line-defect and dot-defect, forming some results as following:

1, obtaining the spectrum distribution of the photonic crystal with line-defect, as shown in Figure 1; 2, obtaining the optical field distribution of the photonic crystal with T-defect, which has the same characteristics with optic beam splitter, as shown in Figure 2; 3, As to photonic crystal with dot-defect, we get the spectrum distribution of the dot, as shown in Figure 3, which can be used in WDM; 4, We combine the photonic crystal with dot-defect with the one with line defect, and obtain the spectrum distribution of the dot, as showing in Figure 4, which can be used in a filter.

Reference

- [1] 征,李景,道中等.多光子晶波器研究[J].光,2002,22(1):79-84.DOI:10.3321/j.issn:0253-2239.2002.01.017.
- [2]周利斌,良瑞.由克斯方程推光子晶本征方程[J].科技新,2010,(24):1-1.DOI:10.3969/j.issn.1674-098X.2010.24.001.
- [3]臧克,李大海等.基于comsol件的光子晶通信器件模[J].光技术应用,2010,25(5):51-53.DOI:10.3969/j.issn.1673-1255.2010.05.014.
- [4]梁文耀.光子晶光特性及其用的究[D].中山大,2010.
- [5]池,曾,姜淳等.光子晶光的原理、用和究展[J].光子•激光,2002,13(5):534-537.DOI:10.3321/j.issn:1005-0086.2002.05.027.
- [6]王磊,殷海,岳玲娜等.任意形二介光子晶算[J].空子技,2008,(2):11-17.DOI:10.3969/j.issn.1002-8935.2008.02.004.
- [7]明.FDTD方法二光子晶特性的究[D].曲阜范大,2008.
- [8]李未,小玲.二三角形光子晶隙合特性究[J].光通信技,2011,35(3):61-62.DOI:10.3969/j.issn.1002-5561.2011.03.019.
- [9]武校.基于有限元法的二光子晶能特性究[D].燕山大,2010.

Figures used in the abstract

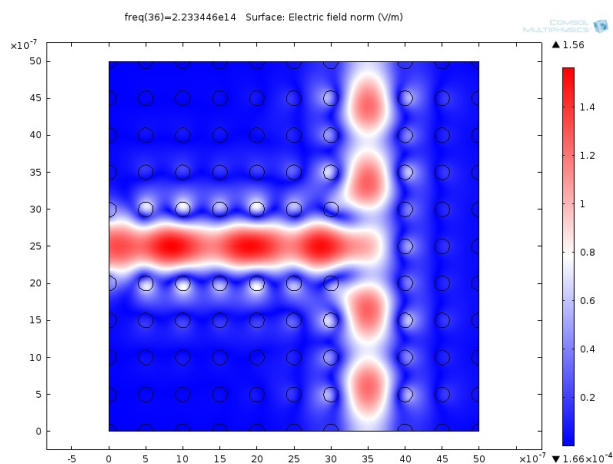


Figure 1

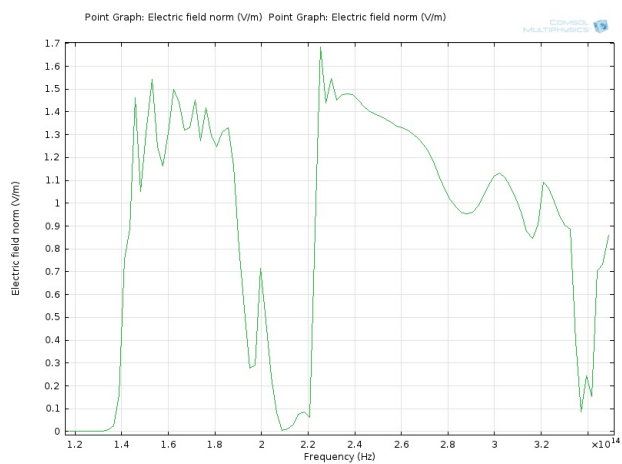


Figure 2

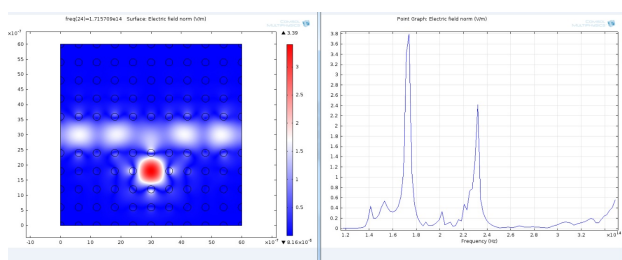


Figure 3

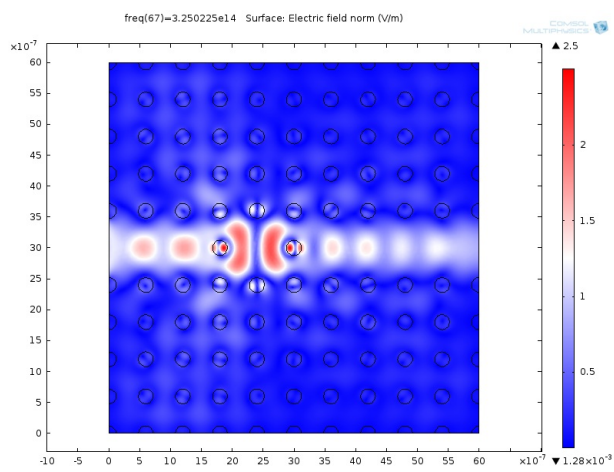


Figure 4