吉首大学学报自然科学版 » 2012, Vol. 33 » Issue (5): 51-55 DOI: 10.3969/j.issn.1007-2985.2012.05.013

虚部光子晶体掺杂介质色散模型

（华南农业大学理学院，广东 广州510642）

Dispersion Model of Doped Medium in Imaginary-Part Photonic Crystal

(College of Sciences,South China Agriculture University,Guangzhou 510642,China)

全文: PDF (403 KB) HTML (1 KB) 输出: BibTeX | EndNote (RIS) 背景资料

摘要 虚部光子晶体的新颖结构使得它具有很强的频率依赖特性，其掺杂介质的色散关系已成为被广泛研究和应用的障碍.利用线性振子的强迫振动模型和有效介质理论，建立虚部光子晶体掺杂介质的色散模型，该色散模型可推广到掺杂多种共振分子材料的情况.通过拟合得到与实验数据相符的色散曲线，从而验证了模型的有效性，有利于进一步研究虚部光子晶体光学特性.

关键词： 虚部光子晶体 强迫振动模型 有效介质理论 色散关系

Abstract: Because of the novel structure,the imaginary-part photonic crystal (IPPC) has strongly frequency-dependent character and some special optical properties.However,the dispersion relation of doped medium of imaginary-part photonic crystal has not been studied clearly,so that it would be an obstacle for wide investigation and application of IPPC.The authors employ linear forced oscillator model and effective medium theory to build up the dispersion model of doped medium of IPPC.The model can be used to more than one kind of doped agent.Finally,the authors compare the simulation dispersion curve from the model with that from experiment and find that they match well.So the dispersion model which the authors build up is available,and it can give some help to get further investigation of IPPC optical properties.

Key words: imaginary-part photonic crystal forced oscillator model effective medium theory dispersion relation

基金资助：

国家自然科学基金(11104083,U0934002)；华南农业大学校长基金资助项目(K08229)

作者简介：刘景锋（1978-），男，山东郓城人，广东省华南农业大学讲师，中山大学博士，主要从事微纳结构中的光与物质相互用研究.

引用本文:

刘景锋,李凌燕. 虚部光子晶体掺杂介质色散模型[J]. 吉首大学学报自然科学版, 2012, 33(5): 51-55.

LIU Jing-Feng,LI Ling-Yan. Dispersion Model of Doped Medium in Imaginary-Part Photonic Crystal[J]. Journal of Jishou University(Natural Sciences Edit, 2012, 33(5): 51-55.

[1] YABLONOVITCH E.Inhibited Spontaneous Emission in Solid-State Physics and Electronics [J].Physical Review Letters,1987，58(20):2 059-2 062.

[2] JOHN S.Strong Localization of Photons in Certain Disordered Dielectric Superlattices [J].Physical Review Letters,1987，58（23）:2 486-2 489.

[3] JOANNOPOULOS J D,JOHNSON S G，WINN J N,et al.Meade,Photonic Crystals:Molding the Flow of Light [M].Princeton:Princeton University

Press,2008:304.

[4] LI J,LIANG B,LIU Y,et al.Photonic Crystal Formed by the Imaginary Part of the Refractive Index [J].Adv. Mater.,2010,22(24):2 676-2 679.

[5] FENG M,LIU Y,LI Y,et al.Light Propagation in a Resonantly Absorbing Waveguide Array [J].Opt. Express,2001,19(8):7 222-7 229.

[6] LI Y,MALOMED B A,FENG M,et al.Arrayed and Checkerboard Optical Waveguides Controlled by the Electromagnetically Induced Transparency [J].Physical Review A,2010,82(6):063 813.

[7] LI Y,MALOMED B A,WU J,et al.Quasicompactons in Inverted Nonlinear Photonic Crystals [J].Physical Review A,2011,84(4):043 839.

[8] JIANG H,LIU J F,CHEN G,et al.Diffractive Properties of Imaginary-Part Photonic Crystal Slab [J].Nanoscale Research Letters,2012,7(1):335-341.

[9] JACKSON J D.Classical Electrodynamics [M].Wiley:Wiley,1998:145-173.

[10] CHOY T C.Effective Medium Theory:Principles and Applications [M].Oxford:Oxford University Press,1999:200-230.

[11] WOOD D M,ASHCROFT N W.Effective Medium Theory of Optical Properties of Small Particle Composites [J].Philosophical Magazine,1977,35(2):269-280.

[12] JACOBSEN K W,STOLTZE P,NRSKOV J K.A Semi-Empirical Effective Medium Theory for Metals and Alloys [J].Surface Science,1996,366(2):394-402.

[13] LALANNE P,LEMERCIER-LALANNE D.On the Effective Medium Theory of Subwavelength Periodic Structures [J].Journal of Modern Optics,1996,43(10):2 063-2 085.

[14] KOSCHNY T,KAFESAKI M,ECONOMOU E N,et al.Effective Medium Theory of Left-Handed Materials [J].Physical Review Letters,2004,93(10):107 402.

[15] 殷之文,电介质物理学 [M].北京：科学出版社，2003：5-8.

[16] ASPNES D E.Local-Field Effects and Effective-Medium Theory:A Microscopic Perspective [J].American Journal of Physics,1982，50(8):704-709.

[17] SHEN L,WU J J,YANG T J.Anisotropic Medium with Parabolic Dispersion [J].Applied Physics Letters,2008,92(26):261 905.

[18] MAKI J J,MALCUIT M S,SIPE J E,et al.Linear and Nonlinear Optical Measurements of the Lorentz Local Field [J].Physical Review Letters,1991,67(8):972-975.

[19] LAGENDIJK A,NIENHUIS B,TIGGELEN V B A,et al.Microscopic Approach to the Lorentz Cavity in Dielectrics [J].Phys. Rev. Lett.,1997,79(18):657-660.

[20] VALERIO LUCARINI J J S,KAI-ERIK PEIPONEN,ERIK M.Vartiainen.Kramers-Kronig Relations in Optical Materials Research [M].[S.l.] Springer,2010:172-176.

[21] STOCKMAN M I,KURLAYEV K B,GEORGE T F.Linear and Nonlinear Optical Susceptibilities of Maxwell Garnett Composites:Dipolar Spectral Theory [J].Physical Review B,1999,60(24):17 071-17 083.

电话传真：0743-8563684　E-mail：xb8563684@163.com　办公QQ：1944107525