光子学报 2012, (4) 436-441 DOI: 10.3788/gzxb20124104.0436 ISSN: 1004-4213 CN: 61-1235/O4

论文

一维光子晶体斜入射波包的带隙结构

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摘要:

对波包的任意傅里叶分量进行坐标变换后,利用转移矩阵法推导出波包斜入射情形下一维光子晶体的色散关系表达式,利用色散关系曲线分析得出波包斜入射的第一带隙结构,与以往平面波的第一带隙结构不同,波包的带隙宽度小于平面波的带隙宽度,并且在位置上前者带隙包含在后者内部.比较了一维光子晶体分别在波包入射与平面波入射情形下带隙位置和宽度,分析了波包中心入射角的变化以及波包的角分布范围的变化对带隙结构的影响,得到了一维光子晶体对波包斜入射的带隙结构的基本特征,确定了计算波包带隙能够近似当作平面波处理的条件.研究表明,波包的带隙结构受入射角大小和波包角分布范围的影响.入射角越小,波包入射的带隙结构越接近平面波;波包的角分布范围越小,光子晶体对波包的带隙宽度和位置越接近平面波.

关键词: 一维光子晶体 波包 色散关系 带隙 角分布

Band Structure of 1-D Photonic Crystal for Oblique Incident Electromagnetic Wave Packet

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Abstract:

Dispersion relation of 1-D photonic crystal is deduced by the method of transfer matrix, with coordinate transformation of arbitrary Fourier exponent of electromagnetic wave packet which is obliquely incident. By analyzing the dispersion relation, it is easy to find the difference between the first band gap under obliquely incident wave packet and that of plane wave, respectively. Meanwhile, the former gap is located in the latter one, for the former one is narrower than the latter one in width. Characteristic of band gap is obtained under obliquely incident wave packet, by comparing the first band gap structure with that of plane wave considering edge position and width of the gap. The condition of approximately substituting plane wave for wave packet to calculate band gap is analyzed, according to related factors such as different incident angle of central wave vector and angle spectrum of wave packet. The results demonstrate that the first band gap structure is closely related to incident angle of central wave vector and angle spectrum of wave packet. With smaller incident angle, the first band gap structure caused by wave packet would become closer to that of plane wave; and with smaller angle spectrum of wave packet, the width and position of the first band gap is closer to those of plane wave.

Keywords: 1-D photonic crystal Electromagnetic wave packet Dispersion relation Band gap Angle spectrum

收稿日期 2011-07-22 修回日期 2012-01-19 网络版发布日期

DOI: 10.3788/gzxb20124104.0436

基金项目:

国家自然科学基金委员会青年基金(No.11104083)资助

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