

论文

基于对称广义Fibonacci光子晶体结构的电光可调谐滤波器

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摘要:

本文构建了含有电光材料LiNbO₃的一维对称广义Fibonacci光子晶体结构,提出并设计了一种基于该结构的可调谐滤波器,并利用传输矩阵法对设计的滤波器的可调谐滤波特性进行了理论研究.数据模拟结果表明:保持对称广义Fibonacci光子晶体的几何结构不变,通过改变电极所在处施加在电光介质(LiNbO₃)层上的外加电场,即可实现滤波器的滤波通道波长的调节,滤波通道波长的改变与外加电压呈线性关系,随着外加电压的增加,滤波通道波长向短波长方向移动.此外,电压一定时,通道波长随光的入射角的增加向短波长方向移动;光的入射角一定时,外加正电压下,通道波长随电压增加发生蓝移,而外加负电压下,通道波长随反向电压的增加发生红移.最后,讨论了双电场作用下的多通道波长滤波器的结构极其特性.以上结果对于新型光子晶体器件的设计具有重要的参考价值.

关键词: 广义Fibonacci序列 电光效应 光子晶体 可调谐滤波器

Electro-optical Tunable Filter with Symmetric Generalized Fibonacci Photonic Crystal

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Abstract:

A structure of symmetric generalized Fibonacci photonic crystal is proposed to design the electro-optical tunable filters based on the electro-optical effect of LiNbO₃ material. The characteristics of the tunable filter are theoretically investigated by the transfer matrix method. The numerical simulation results show that the channel wavelength of the filter can be modulated by the external electric field which is applied on the LiNbO₃ layers without changing the geometrical structure of the symmetric generalized Fibonacci photonic crystal, and the channel wavelength will linearly move to short wavelength as the increase of the external electric voltages. In addition, if the external electric voltage is fixed, the channel wavelength will move to short wavelength as the increase of the incident angle; if the incident angle is fixed, the channel wavelength will move to short wavelength for the increase of plus external electric voltage, while the channel wavelength will move to long wavelength for negative external electric voltage. Lastly, the characteristics of the tunable multi-channel filter with double external electric fields are discussed. It provides an important reference for design of novel photonic crystal devices.

Keywords: Generalized Fibonacci sequence Electro-optical effect Photonic crystal Tunable filter

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