

## 论文

### 基于宽度可调节的线缺陷平板型光子晶体的空气槽微腔

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摘要:

研究了一种空气槽光子晶体微腔,这种腔是由在平板型光子晶体上引入一条宽度可以调节的线缺陷空气槽形成的.腔模的电场被强烈局限在空气槽中,由于介电常量的不连续性,电场得到很大的提高,同时模体积被大大地降低.数值模拟与分析了微腔的能带结构和场分布,考虑到腔模的谐振频率和对称性,发现一阶偶模同时具有较高的品质因子和较小的模体积;应用有限时域差分法,得到腔模的品质因子可以高达 $10^6$ ,模体积仅为 $0.02(\lambda/n)^3$ .计算了一阶偶模谐振波长随空气槽宽度以及空气孔半径的变化,发现随着宽度的增加,波长越来越短.而随着空气孔半径的增加,波长近似线性地减小;当空气孔半径为170 nm时,可以获得最高的腔品质因子.

关键词: 光子晶体 光学微腔 有限时域差分法 品质因子 模体积

### An Air-slot Cavity Based on Width-modulated Line Defect Photonic Crystal Slab

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Abstract:

An air-slot photonic crystal cavity is studied based on the design of an air-slot in a width-modulated line-defect in a photonic crystal slab. The electric field of the cavity mode is strongly localized in free space. Owing to the discontinuity of the dielectric constant, the electric field of the cavity mode is strongly enhanced inside the slot and the mode volume is strongly compressed. The cavity band structure and cavity modes of this air-slot photonic crystal cavity are numerical simulated and analyzed. According to the resonant frequency and the symmetry of the cavity modes, the first order even mode has both high quality factor and small cavity volume. Using finite-difference time-domain method, the calculated quality factor is as high as  $10^6$  and the mode volume is as small as 0.02 of a cubic wavelength in a vacuum. Additionally, the properties of the first order even cavity mode as a function of the slot width and the radius of the holes are calculated. The resonant frequency of the first order even mode is decreased with the slot width and radius of the holes. But when the radius of the holes are 170 nm, the highest quality factor of the air-slot photonic crystal cavity is obtained.

Keywords: Photonic crystal cavity Optical microcavity Finite-difference time-domain method Quality factor Mode volume

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