Strongly Localized State of a Photon at the Intersection of the Phase Slips in 2D Photonic Crystal with Low Contrast of Dielectric Constant

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Abstract

Two-dimensional photonic crystal with a rectangular symmetry and low contrast (¡ 1) of the dielectric constant is considered. We demonstrate that, despite the absence of a bandgap, strong localization of a photon can be achieved for certain "magic" geometries of a unit cell by introducing two $\pi/2$ phase slips along the major axes. Long-living photon mode is bound to the intersection of the phase slips. We calculate analytically the lifetime of this mode for the simplest geometry: a square lattice of cylinders of a radius r. We find the magic radius, r_c, of a cylinder to be 43.10 percent of the lattice constant. For this value of r, the quality factor of the bound mode exceeds 10^6. Small (1%) deviation of r from r_c results in a drastic damping of the bound mode.