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Extended Range Ultra-Refractive One-Dimensional Photonic Crystal Prisms

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Abstract

In photonic crystals, electromagnetic radiation with frequency just outside the photonic band gaps can propagate with highly unusual characteristics. Kosaka and co-workers demonstrated very strong color-dispersion capability, called the superprism or ultra-refractive effect, in a 3D photonic crystal. [*J. Lightwave Technol.* **17**, 2032 (1999)]. In this work we describe theoretical analysis and design of one-dimensional photonic crystal prisms. We found that in a prism geometry, the unconventional refraction properties of 1D photonic crystals can be used for wavelength dispersion over entire photonic bands, rather than just near the band edges outside photonic band gaps. The use of a 1D photonic crystal simplifies the design and fabrication processes. The use of entire transmission bands broadens the useful wavelength range, admits better optical transmission, and exhibit angular dependence on wavelength with greatly reduced non-linearity. The availability of higher bands also allows the use of photonic crystals with larger feature sizes, thereby reducing fabrication requirements. The properties of the ultra-refractive 1D photonic crystal prism can be tuned by varying design parameters such as incidence angle, exit surface angle, and layer widths. The 1D photonic crystal prism can be fabricated in a planar process, and can be used as elements in optical integrated circuits.

Keywords: photonic crystal, one-dimensional, prism, ultra-refraction

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