

# Compact four-port circulator based on 2D photonic crystals with a 90° rotation of the light wave for photonic integrated circuits applications

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A four-port optical circulator based on two-dimensional square lattice photonic crystals is reported. It is simple besides the brief framework. The crystalline geometrical structure of the circulator makes 90° non-reciprocal transmissions of electromagnetic waves with low insertion loss and high levels of isolation by the diligence of magneto-optic crystals. The structure is novel because it uses a resonant cavity with a simple design. Also, in comparison to prior models, the proposed four-port circulator utilizes a two-dimensional square lattice crystal structure with a cylindrical ferrite section of the  $\pi/4$  Faraday angle. The finite element method is used for this anisotropic medium to get the tensor elements in this simulation. The importance of the gyromagnetic properties of ferrite crystals for the non-reciprocal transmission is investigated. Furthermore, the corresponding S-parameters for this circulator are analyzed and reported. Due to the compact size and ease of fabrication, this device can be realized for applications such as splitting and isolation in photonic integrated circuits.