Cavity coupled high-Q resonance Topological Ring Resonator in Microwave regime

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Topological photonic crystal (TPC) is the new field of photonics seeks to create and manipulate the EM waves with "topological" properties, the history of topological photonic crystals is intertwined with developments in both condensed matter physics and photonic crystal research; this is new sub field of photonics. Topological photonics has attracted a lot of attention in study over the last several years because of its fascinating properties, which include robustness in transmission, energy transport without reflection, and immune to backscattering [1]. The simulation examining of electromagnetic energy transmission in a metal-based TPC is hence the main emphasis of this work. By connecting a triangular-shaped ring resonator at a distance of 0.8 cm with a straight topological waveguide, a topological channel is formed across the zigzag domain border. Furthermore, this work can offer a strong foundation for achieving high Q-factor, lossless, and reliable energy conveyance.

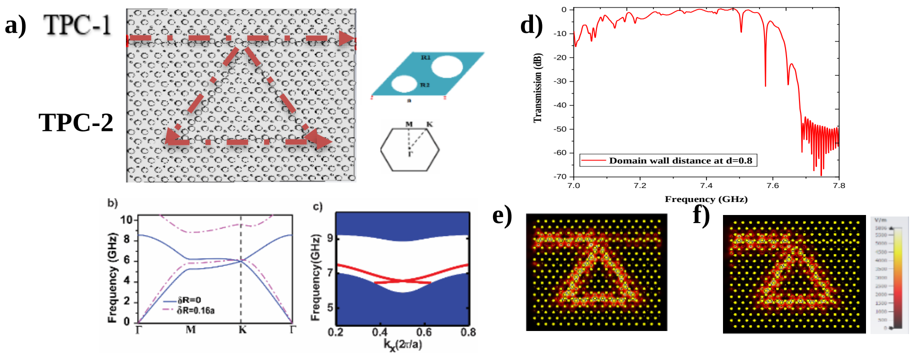

Figure 1(a) illustrates the schematic of our proposed TPC consisting of an evanescently coupled triangular ring resonator (TRR) to a straight topological waveguide. (b) Bulk band topology for δR=0 and δR =0.16a. (c) Projected band diagram of the TPC with red solid lines indicating the excited edge states and blue shaded region indicating the bulk photonics bands. (d) Simulated transmission spectra of our studied TPC in-plane (XY) electric field distribution of the electric field at 7.504GHz and 7.578GHz. (e & f) The propagation of EM energy with in the proposed structure at the two different frequencies.

The schematic of our proposed TPC is illustrated in Fig. 1(a), which consists of a of an evanescently coupled triangular ring resonator (TRR) to a straight topological waveguide. The underlying lattice comprises a hexagonal arrangement of two geometrically perturbed Aluminum (Al), rods patterned on a 2mm thick Al substrate. As shown in Fig. 1(b), illustrates the Dirac degeneracy for the unperturbed TPC's (δR=0) at K(K') point. As evident in Fig. 1(b), a geometrical perturbation of 0.16a in the rod diameter leads to lifting of the Dirac degeneracy and thereby opening up a topological band gap of ~2.65GHz [2]. The coupling of TPC-1 and TPC-2 through the zigzag domain boundary leads to the excitation of TESs, as evident from the green solid lines of Fig. 1(c). The red solid lines indicate the excited edge states inside the white shaded photonic band-gap region. In addition, the red solid line. Fig. 1(d) depicts the transmission spectra of our studied structure across the frequency range 7 to 7.8GHz. Here, we notice, expect the sharp transmission dips, a robust transmission of 0dB across the investigated frequency range. To elucidate the occurrence of sharp transmission dips, we study the electric field profiles at frequencies 7.504GHz and 7.578GHz in Fig. 2(b) and Fig.2(c) respectively.

References

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