Meetings International SciTechnol

Colak E et al., J Nanomater Mol Nanotechnol 2018, Volume: 7
DOI: 10.4172/2324-8777-C4-029

International Conference on

NANOTECHNOLOGY AND NANOENGINEERING

July 16-18, 2018 | Paris, France

Unidirectional and bidirectional beam splitting in photonic structures due to diffraction with defect layer replacing interface corrugations

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Unidirectionality and dual-beam splitting are observed in a photonic crystal (PC) structure including a single defect layer which is sandwiched between two slabs of PC, elliminating grating-like interface layers (Fig. 1). The embedded defect layer, being a diffractive element, enforces strong diffractions. Efficient splitting and occurance of strong diffractions strongly depend on the dispersion properties of the Floquet-Bloch modes of PC. Asymmetric transmission feature Unidirectional and bidirectional splitting under normal incidence, which are associated with, arises from the dominant contribution of m=±1 diffraction orders. Also examining a coupled-cavity defect for two different permittivity values, wideband unidirectional splitting is obtained in both cases (Fig. 2).

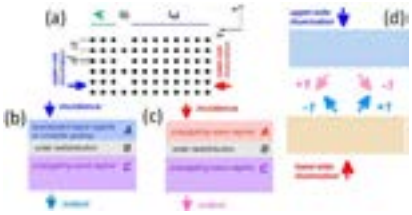

Fig. 1. (a) Finite-thickness slab of PC with a defect layer; showing upper/lower side illumination when zero order is (b) not coupled or (c) coupled at the upper interface, and (d) diffraction inspired splitting mechanism.

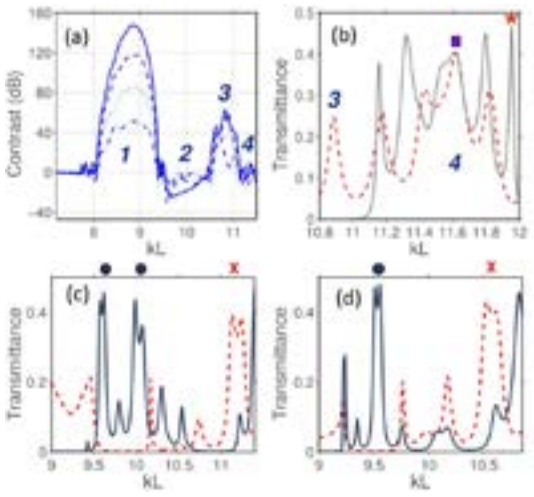

Fig. 2. (a),) for the structure in when defect layer is 2nd (solid), 3rd (dashed), 4th (dotted), and 5th (dash-dotted) layer from upper interface; (b), (dashed red) and solid gray), defect being the 3rd layer from upper interface; '' and '*' indicate = and / 10, respectively. (red dashed line and (navy solid line) for upper and lower illumination of coupled cavity (c) d/a=0.4, ε=5.8, (d) d/a=0.4, ε=9.61; crosses and circles indicate upper and lower unidirectional splitting regimes, respectively.

Biography

Evrim Colak earned his PhD from the Electrical and Electronics Engineering Department of Bilkent University, Ankara, Turkey in 2012. His research interests cover Metamaterials, Photonic Crystals, Microwave, RF Circuits, Photonics, Optics, computational electromagnetics and Biomedical applications. He is a faculty member in Electrical and Electronics Engineering Department, Ankara University, Ankara, Turkey. He has published 20 papers in SCI and SCI-E journals.

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