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



## Multi-frequency low-pass, band-pass and band-stop type spatial filtering in a photonic crystal

**Colak E[1], Serebryannikov AE[2], Petrov A[3], Usik PV[4], Ozbay E[5]**
[1]Ankara University, Turkey
[2]Adam Mickiewicz University, Poland
[3]Hamburg University of Technology, Germany
[4]National Academy of Sciences of Ukraine, Ukraine
[5]Bilkent University, Turkey

Spatial filtering of light may be important in sensor applications. Spatial low-pass, band-pass, band-stop filtering [1, 2] of incident light (λ=1.5μm) in angle domain at different frequencies in the same photonic crystal in Fig. 1(a) are studied. Dispersion of Floquet-Bloch modes and shape and locations of equifrequency contours (EFC) in the first Brillouin zone [3] dictate the type of spatial filtering shown in Fig. 1(b) to 1(f). Varying the ratio of rod diameter (d) to lattice constant (a) or number of layers (N) enable spatial band-stop, low-pass and band-pass filtering (Fig. 2(a) and Fig. 2(b)). Transmission value of unity can be obtained for different incident angles, different frequencies and different number of layers (Fig. 2(b) to 2(d) and Fig. 2(f) to 2(h)).

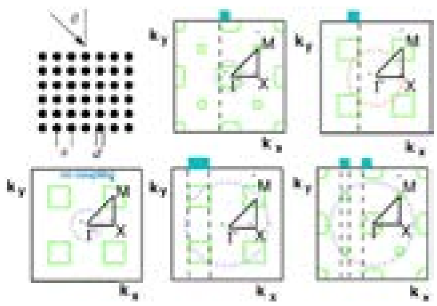

Fig. 1(a) PC structure under oblique incidence, spatial filtering of transmission for (b) Low-pass, (c) high-pass, (d) no-transmission, (e) band-pass, (f) band-stop cases.

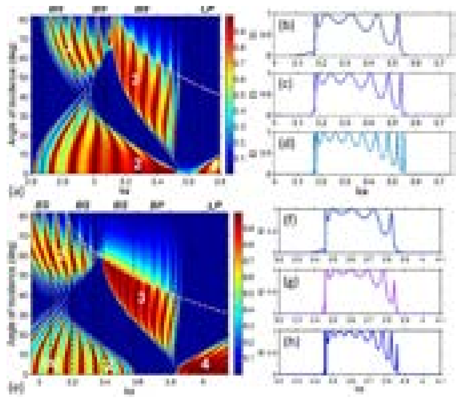

Fig. 2. (a) Map of t0 in (ka,θ)-plane at d/a = 0.443, ε = 9.61, and N = 8; straight vertical lines– approximate boundaries of ka-ranges that can be used for bandstop (BS) and low-pass (LP) spatial filtering; (b–d) Transmission (t0) vs ka at d/a = 0.443, ε = 9.61, θ = 47◦, and (b) N = 6, (c) N = 8, and (d) N = 12. (e) Map of t0 in (ka,θ)-plane at d/a = 0.400, ε = 9.61, and N = 12; straight vertical lines– approximate boundaries of ka-ranges that can be used for bandstop (BS), bandpass (BP) low-pass (LP) spatial filtering. (f–g) Transmission (t0) vs ka at d/a = 0.443, ε = 9.61, θ = 40◦, and (f) N = 6, (g) N = 8, and (h) N = 12; In (a) and (e). Large numbers in (a) and (e): 2, 3 and 4, indicate transmission area due to the corresponding Floquet–Bloch mode; dashed curve – threshold line for the diffraction order m = −1.

### 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 SCIE journals.

ecolak@ankara.edu.tr

**Notes:**