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Photon localization in an aperiodic crystal lattice JOSEPH HOLMES, BOGDAN DRAGNEA, Indiana University, Chemistry Department —
To design photonic crystals it is essential to engineer the location, size, and shape of the bandgap. In the current study we numerically investigate a conceptually new approach to photon localization in 2D photonic crystal structure in which the underlying lattice is one based on deterministic aperiodic order. The basic model involves parallel dielectric rods arranged on three types of 2D lattices that are fundamentally different: (1) a conventional hexagonal lattice, (2) a random lattice, (3) and a deterministic aperiodic array based on the algorithm of phyllotaxis. From preliminary 2D FDTD calculations, we have seen that conventional crystalline structures, those based on periodicity, do not allow for the isotropic confinement of light. This problem can be solved by designing photonic crystals where the arrangement of dielectrics is based on an algorithm for deterministic aperiodic order. The phyllotactic array adopts an original inflation-deflation symmetry instead of the translational and rotational symmetries of classical crystallography and possesses the highest homogeneity and radial isotropy in the 2D circular domain. Inevitably the aperiodic photonic crystal might be utilized for enhanced light source, waveguide, and in the design of a new class of optical fibers.

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