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Design and Characterization of Novel Focusing Elements Based on Photonic Metamaterials

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Abstract

New results in the development of photonic metamaterials based on two dimensional periodic dielectric structures are reported. We show that concave and flat lenses consisting of homogeneous or inhomogeneous dielectric rods can focus electromagnetic waves in spectral regions characterized by effective refractive index $n_{\text{eff}} < 1$. In particular, a triangular-lattice photonic crystal— assembled from multilayer dielectric rods designed to approximate a fish-eye profile—is shown to exhibit negative refractive index and good focusing properties at microwave frequencies where the fish-eye dielectric rods scatter the light like a medium with negative refractive index. In some cases the focusing phenomenon proves to be accompanied by super-resolution. The obtained results may be used for the purpose of designing and manufacturing (down scaled) novel micro-lenses for optical integrated circuits.

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