physica status solidi a applications and materials science

2005, Volume 202, Number 4, pag. R35-R37

Efficient focusing with a concave lens based on a photonic crystal with an unusual effective index of refraction

Foca E., Föll H., Daschner F., Sergentu V. V., Carstensen J., Frey S., Knöchel R., Tiginyanu I. M.

https://doi.org/10.1002/pssa.200510003

Abstract

This work reports measurements with a concave lens based on a photonic crystal (PC) structure, which was designed to have an effective index of refraction n eff < 1 or even < 0, and which is intended as a model system for future down-scaled optical elements based on PCs with an unusual effective index. The dimensions of the model PC were optimized for experiments in the microwave regime around 10 GHz. Calculations for a material with no losses allowed to select the wavelengths for which the lens could be expected to behave as a homogeneous meta-material with an unusual effective refractive index. The field distribution behind the lens was measured, and good focusing efficiencies for n eff < 1 were found for perfect and strongly disturbed PC's in reasonable accordance with the predictions. The (down-scaled) model system investigated thus can serve as a reference for testing PC-based optical elements made from materials which so far elude reliable predictions, e.g. doped semiconductors, nanorod assemblies, or meta-materials with anisotropic behavior.