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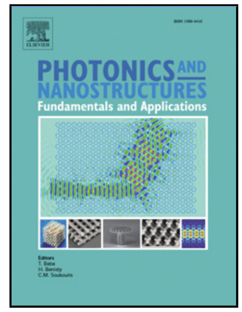

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Authors: Shuo Li, Fei Meng, Han Lin, Xiaodong Huang, Baohua Jia

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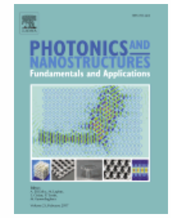

All-angle negative refraction flatlens with a broad bandwidth

Shuo Li,[a] Fei Meng,[b,d] Han Lin,[a] Xiaodong Huang,[b,c,]* Baohua Jia [a,]*

[a] Centre for Micro-Photonics, Faculty of Science Engineering and Technology, Swinburne University of Technology, Hawthorn, VIC 3122, Australia
[b] Faculty of Science, Engineering and Technology, Swinburne University of Technology, Melbourne, VIC 3122, Australia
[c] State Key Laboratory of Advanced Design and Manufacturing for Vehicle Body, Hunan University, Changsha 410082, China
[d] School of Civil Engineering, Central South University, Changsha 410075, China
*Corresponding author: huang.xiaodong@rmit.edu.au, bjia@swin.edu.au

* *Corresponding author.*
E-mail address: huang.xiaodong@rmit.edu.au
bjia@swin.edu.au

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ABSTRACT

All-angle negative refraction (AANR) contributes to a subwavelength imaging with the ability to collect light from all incident angles to generate negative refraction. However, it is challenging to realize a broadband AANR with the conventional photonic crystal (PhC) structures due to the dispersion nature, which makes the refracted light highly sensitive to the incident angle. In this work broadband AANR PhCs are proposed based on the supercircle void or rod design, for transverse electric (TE) and transverse magnetic (TM) polarizations respectively. By adjusting the filling ratio of the dielectric material, the nearly optimal AANR range is realized. Flat lenses based on the supercircle designs are able to form subwavelength imaging in a frequency range 3 times broader than the state-of-the-art for TE polarization and 1.1 times for TM polarization, respectively.
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1. Introduction

Negative refraction attracts great attention because of their ability to realize flat lenses for high resolution imaging, e.g. subwavelength focusing, without the need of the conventional bulky optics. Negative refractive index (NIM) materials have been extensively studied as the flat lens candidates. However, requiring metallic lossy materials to realize both negative permittivity and permeability has made this scheme less attractive in practical applications, in particular in the optical range [1, 2]. On the other hand, recently a large number of studies focus on all-dielectric metamaterial and metasurfaces with less loss [3-6]. But the complexity of structures, the sophisticated fabrication process, as well as limited working wavelength range still limit the application of metamaterials. Compared with the metamaterial structures, photonic crystals (PhCs) are composed of dielectric periodicities, which are almost lossless in the optical frequency region. In

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