Scientists design new lens with dual function set to revolutionise optical devices

Posted on Tuesday 13th November 2012

Scientists at the University of Birmingham have designed a lens using metamaterials that can function as a convex or a concave lens, according to research published today (13 November 2012) in the journal Nature Communications. By fabricating gold nano-rods on the glass, this new lens can magnify or demagnify objects, just by switching the polarisation of the light source.

The lens has an aperture of 80 micrometers - roughly the size of the cross-section of human hair - and a focal length of 60 micrometers.

Lenses are the key part of imaging systems such as telescopes, microscopes and cameras and are widely used in industry to manufacture silicon chips. A lens is an important optical component, the core of most optical devices, used in cameras, medical imaging, astronomy, optical lithography and integrated circuits.

The key to designing a conventional lens, which is usually manufactured out of glass or another transparent material, is to make a curved surface. These lenses are either convex - converging light, which magnifies an object, or concave, where light diverges making an object smaller.

However, this new lens is 40 nm thin on a flat glass surface. In order to create a dual function lens, which can be switched from convex to concave, the researchers have developed an array of gold nano-structures, which is placed on top of the glass, which enables them to control the propagation of light. Then, by changing the helicity (left or right handed rotation of the electric field) of the light shining through the lens, the same lens can function as a concave or convex lens.

Dr Shuang Zhang, Reader in Metamaterials at the University of Birmingham's School of Physics and Astronomy, and lead investigator, said: *'This new device, our plasmonic metalens, will give greater flexibility in designing and adding new functionalities to optical systems as the focusing properties of the same lens can be altered between a convex lens and a concave lens at your will. Furthermore, the compact size, and the planar nature of the lens could also have an impact on photonic integrated photonic devices.'*

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Notes to Editors
Researchers at Paderborn University, Germany, Tsinghua University, China, Hong Kong Baptist University and National University of Singapore collaborated on the project.
The research is published in the journal Nature Communications.
The DOI for this paper is 10.1038/ncomms2207

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