NRN113

Advanced Optical Superlens and Nanoscope for Nanoscale Imaging and Patterning

Introduction

At Bangor we have pioneered new optical superlenses including 'microsphere superlens (2011)', 'spider silk superlens (2016)' and 'nanoparticle-made metamaterial superlens (2016)', all were published in top journals (Nature Communication, Nano Letters, Science Advances) and widely publicised (BBC, New York Times etc). The recent design of 'Bangor superlens' was patented (PCT/GB2014/052578) and of great potential for commercial exploitation. The superlens product can find applications in bio-imaging, nanofoucsing, nanolithography, nano-solar energy concentrator, nanochemistry, nanomedicine areas.

Nanoparticle –made metamaterial Superlens

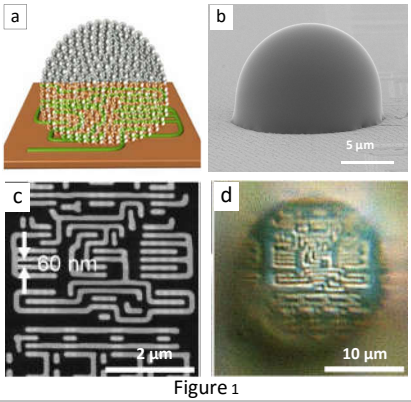

Figure 1

We designed a new superlens based on metamaterial concept. This metamaterial superlens was synthesized of high-index TiO_2 nanoparticles. Hemispherical block was formed on sample with nanoscale features. Such design possesses exceptionally high optical resolution in visible light, approximately 45nm.

Sci. Adv. 2, e1600901 (2016).

Commercially Viable Bangor Superlens – Imaging and Patterning

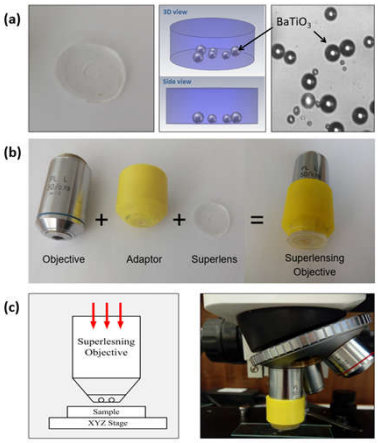

Figure 2

New superlens suitable for scanning was developed and the key concept is illustrated in fig 2. An integrated objective lens consists of conventional objective lens and a Coverslip Microsphere Superlens (CMS). This provide user-friendly way for operator working with nanoscale imaging and laser patterning.

Results show the super-resolution capability of Bangor superlens in scanning imaging fig.3(a)~(c) and nano-patterning fig.3(d)~(f) .

Appl. Opt., 56, 3142-3147 (2017).

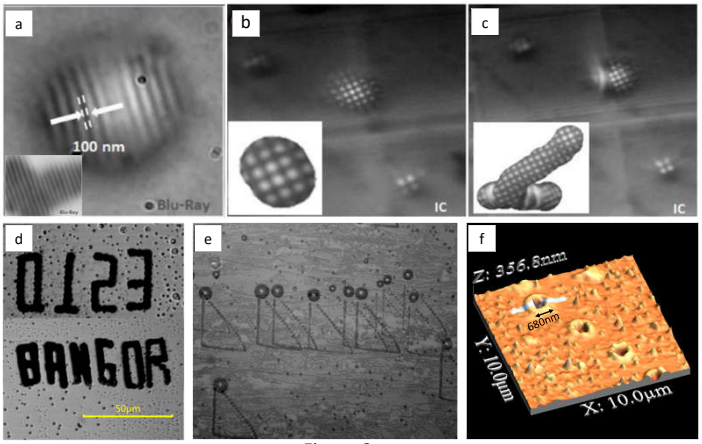

Figure 3

Spider Silk Superlens

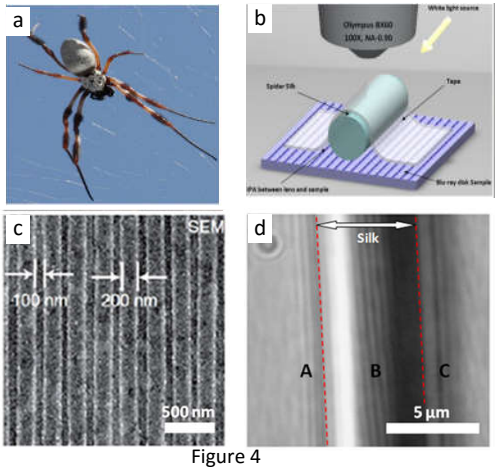

Figure 4

We also extended our research to the material from nature. Here, we report a first biological superlens - spider silk superlens. This natural bio-superlens can clearly resolve sub-diffraction 100nm features fig.4(d) under white light condition. And it has advantage in lager field of view compared to microsphere superlens. The spider silk nanoscope is robust and economical, providing a minimum manufacturing platform for future commercial endeavors.

Nano Lett., 16(9), 5842–5845 (2016).

Future Vision

Our vision is that every microscope user will have the 'Bangor superlens' products in their hand for daily use of microscopes, enabling super-resolution imaging technology fully accessible.

Media Link

http://www.bbc.com/news/uk-wales-north-west-wales-37154394
http://phys.org/news/2016-08-invisible-visible-superlens-nanobeads.html
https://www.youtube.com/watch?v=nOtkMoPh4Yw
https://www.youtube.com/watch?time_continue=1&v=GoS7JVNFLpk

Contact Details

Bing Yan (PhD student)
School of Electronic Engineering,
Bangor University
eep418@bangor.ac.uk

Dr. Zengbo Wang (PI)
School of Electronic Engineering,
Bangor University
zengbo.wang@gmail.com

Swansea University Prifysgol Abertawe
Cardiff University Prifysgol Caerdydd
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