Three-dimensional cross-nanowire networks recover full terahertz state

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Funder(s): EPSRC, ARC (Australia), and the European Union's Horizon 2020.

Abstract: This work reports a nanotechnology-based detector using 3D cross-nanowire networks that records the full polarization state of Terahertz pulses. Terahertz radiation, the spectral region between microwaves and infrared light, is particularly useful for key applications, e.g. medical imaging, security screening, communications and quality control. This work paves the way for future on-chip imaging systems for cancer detection and security scanners.

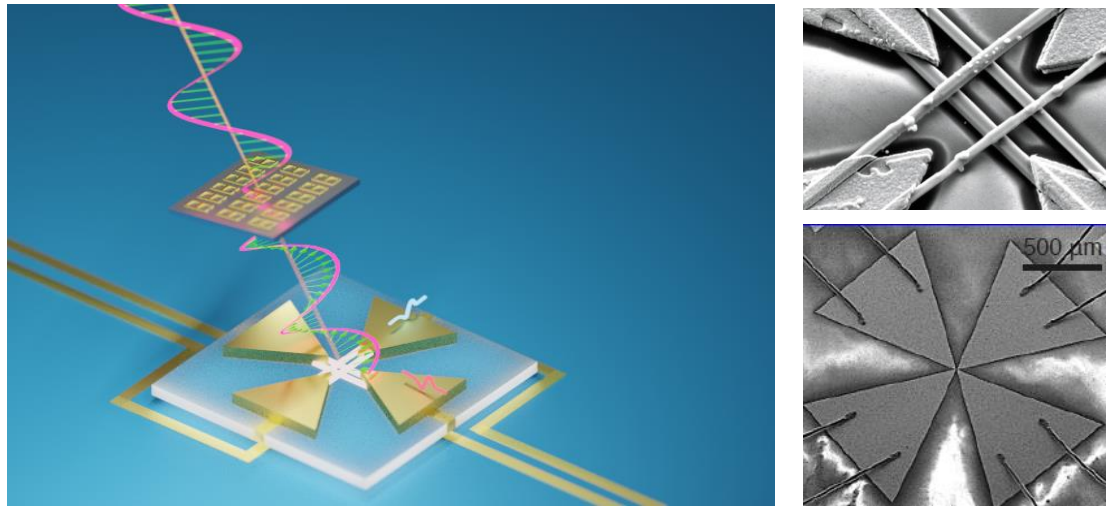

Fig. 1. Diagram and SEM images of the developed nanowire THz detector

Novel form of nanoscale detector for Terahertz radiation

Terahertz radiation lies between microwaves and infrared. It is a non-ionising radiation, important in applications including security and biomedical imaging. Whilst current systems use simple intensity detection, this new nanoscale detector permits measuring the polarisation of terahertz radiation; hence opening the door for improved imaging techniques. Strathclyde's role was in the construction of a 3D lattice of nanowires in orthogonal patterns onto metal antenna structures using a highly-accurate 'transfer printing' micro-assembly technique. The nanowires' orientation allows terahertz radiation with different polarisations to be measured independently, and given the compact device area, paves the way for future on-chip imaging systems.

Key Results

- New THz detector based on crossed nanowires (nano-hashtag) able to resolve the full state of THz light
- Novel nanophotonic platform paving the way to high-speed, high-accuracy, on-chip THz pulsed imaging.
- A 'transfer printing' micro-assembly technique was used to fabricate the 3D nano-hashtag, 'printing' nanowires individually with nanometric positioning accuracy and full orientation angle control.
- The capabilities and geometry of the THz detector open up new scientific applications spanning physics, biology, chemistry, and engineering, while potentially enabling new approaches to industrial quality control, security imaging, and high-speed communications.

K. Pen et al., Science 368 (6490), 510 (DOI: 10.1126/science.abb0924)