Hot developments in infrared photodetector technology

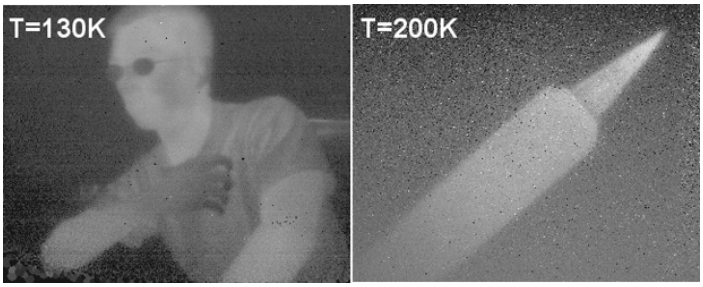
Researchers at Northwestern University, US, have made a significant advance in the development of infrared photodetectors that could lead to new imaging techniques for use in medicine, environmental monitoring, night vision and remote sensing from space.

Infrared detectors are highly sensitive to heat, and in order to minimise noise in the signal, detector hardware is typically cooled to 77 Kelvin, or around –200°C. The cryogenics required for achieving such low temperatures add significant costs, bulk and power consumption to the detectors, severely limiting their usability.

Quantum dots – also known as nanocrystals or 'artificial atoms' – display a number of interesting electronic and optical properties. With their small size the particles possess a physical property known as three-dimensional confinement, and this means they can operate at relatively high temperatures when used in infrared detectors.

The Northwestern researchers have developed quantum dot infrared photodetectors (QDIPs) based on a hybrid indium arsenide quantum dot and indium gallium arsenide quantum well structure grown on an indium phosphide substrate. The QDIPs can operate at room temperature, and have a maximum quantum

Focal plane array images taken at 130 and 200 Kelvin



Source: Manijeh Razeghi/Northwestern University

efficiency of 48%. An infrared camera incorporating the QDIPs was used to demonstrate thermal imaging at temperatures of up to 200 Kelvin.

'Our efficiency value is unprecedented for a quantum dot-based device, and shows the potential for quantum dots to overcome the low efficiency limitations of quantum well photodetectors,' says research leader Manijeh Razeghi.

In the short term, Razeghi and her colleagues hope to improve the performance of their photodetectors by reducing the operating bias. The longer term goal of the research is high performance and high operating temperatures through optimisation of the growth of the quantum dots.

Application development is currently focused on imaging arrays, and while the researchers are not looking at commercialising the technology themselves, they are open to doing so through industry collaborations.

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