McCormick News Article

Researchers Create World’s First High Performance Infrared Camera Based on Type-II InAs/GaSb Superlattices

Nov 15, 2010 1:00 PM

Researchers at Northwestern University have created a new infrared camera based on Type-II InAs/GaSb superlattices that produces much higher resolution images than previous infrared cameras.

Created by Manijeh Razeghi, Walter P. Murphy Professor of Electrical Engineering and Computer Science, and researchers in the Center for Quantum Devices in the McCormick School of Engineering and Applied Science, the long wavelength infrared focal plane array camera provides a 16-fold increase in the number of pixels in the image and can provide infrared images in the dark. Their results were recently published in the journal *Applied Physics Letters*, Volume 97, Issue 19, 193505 (2010).

The goal of the research is to offer a better alternative to existing long wavelength infrared radiation (LWIR) cameras, which, with their thermal imaging capabilities, are used in everything from electrical inspections to security and nighttime surveillance. Current LWIR cameras are based on mercury cadmium telluride (MCT) materials, but the Type-II superlattice is mercury-free, more robust, and can be deposited with better uniformity. This will significantly increase yield and reduce camera cost once the technology goes commercial.

“Not only does it prove Type-II superlattices as a viable alternative to MCT, but also it widens the field of applications for infrared cameras,” Razeghi said. “The importance of this work is similar to that of the realization of mega-pixel visible cameras in the last decade, which shaped the world’s favor for digital cameras.”

Type-II InAs/GaSb superlattices were first invented by Nobel laureate Leo Esaki in the 1970s, but it has taken time for the material to mature. The LWIR detection mechanism relies on quantum size effects in a completely artificial layer sequence to tune the wavelength sensitivity and demonstrate high efficiency. Razeghi’s group has been instrumental in pioneering the recent development of Type-II superlattices, having demonstrated the world’s first Type-II–based 256×256 infrared camera just a few years ago.

“Type-II is a very interesting and promising new material for infrared detection,” Razeghi said. “Everything is there to support its future: the beautiful physics, the practicality of experimental realization of the material. It has just taken time to prove itself, but now, the time has come.”

Tremendous obstacles, especially in the fabrication process, had to be overcome to ensure that the 1024×1024 Type-II superlattice–based camera would have equivalent performance as the previously realized 320×256 cameras. Operating at 81 K, the new camera can collect 78 percent of the light and is capable of showing temperature differences as small as 0.02° C.

Image of CQD graduate student Paritosh Manurkar taken with the world’s first LWIR FPA based on Type-II superlattices.

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