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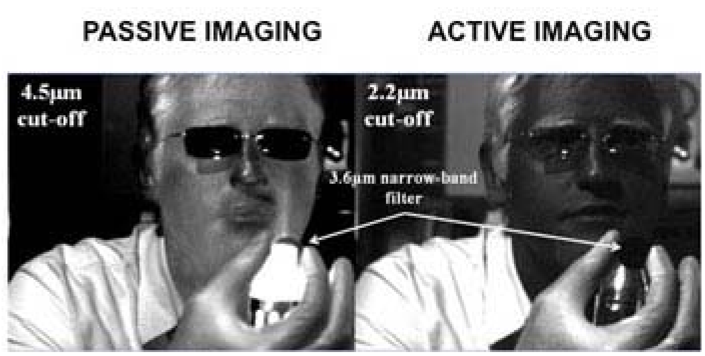
Researchers develop integrated dual-mode active and passive infrared camera



A Center for Quantum Devices researcher holds a heater and a narrow-band filter centered at 3.6µm. The heater can be seen when imaged with the band-pass detectors sensitive up to 4.5µm (left), but not in the ones with shorter detection wavelengths up to 2.2µm (right).

High-performance infrared cameras are crucial for civilian and military applications such as night-vision goggles and search-and-rescue operations. Existing cameras usually fall into one of two types: active cameras, which use an invisible infrared source to illuminate the scene, usually in the near or short-wavelength infrared; and passive cameras, which detect the thermal radiation given off by a warm object, typically in the mid- or long-wavelength infrared, without the need for any illumination. Both camera types have advantages and disadvantages in the field.

Integrating both modes of imaging into a single camera would open new possibilities—but doing so has proven challenging. Until now, dual-mode active and passive infrared cameras needed either two different infrared detectors or complex controllable filters to accommodate the different wavelengths, and then required additional signal processing to reconstruct a single image from the two modes.

However, in a move that may change the way we look a two-color imaging, researchers at the Northwestern University's Center for Quantum Devices have now found a way to integrate active and passive infrared imaging capability into a single chip. This opens the way to lighter and simpler dual-mode active/passive cameras with lower power dissipation.

A paper about the findings, "Active and Passive Infrared Imager Based on Short-Wave and Mid-Wave Type-II Superlattice Dual-Band Detectors," was published January 1 in the journal Optic Letters. The work was led by Manijeh Razeghi, Walter P. Murphy Professor of Electrical Engineering and Computer Science in Northwestern's McCormick School of Engineering and Applied Science.

The researchers achieved this feat by engineering the quantum properties of novel semiconductor materials called the indium arsenide/gallium antimonide (InAs/GaSb) type-II superlattices. Researchers at the center have been pioneering the development of type-II superlattices as a superior replacement of aging mercury-cadmium-telluride (HgCdTe) infrared camera technology in terms of both performance and cost.

Using the unique band-structure engineering capabilities of type-II superlattices, they have developed a new structure incorporating two different superlattices with different layer spacings, thus enabling detection with a cutoff wavelength of either 2.2 µm (active mode) or 4.5 µm (passive mode). This new device can simply switch from passive to active mode by a very small change in bias.

The work was funded by the Defense Advanced Research Projects Agency.

Active and Passive Infrared Imager Based on Short-Wave and Mid-Wave Type-II Superlattice Dual-Band Detectors [1]

Northwestern University [2]

Links:
[1] http://www.ncbi.nlm.nih.gov/pubmed/23282825
[2] http://www.mccormick.northwestern.edu/news/articles/2013/01/researchers-develop-integrated-dual-mode-infrared-camera.html