Nanotechnology Now
Your Gateway to Everything Nanotech

August 11, 2005

III-Vs REVIEW
THE ADVANCED SEMICONDUCTOR MAGAZINE

August 12, 2005

innovations report

August 12, 2005

SPACEWAR
INCORPORATING TERRAWAR.COM

August 12, 2005

[nanotechnology]
YashNanotech
Vision BEYOND the obvious...

August 12, 2005

NORTHWESTERN UNIVERSITY

August 16, 2005

AZoM.com

August 30, 2005

Technology holds promise for infrared camera

New technology developed at Northwestern University has the potential for broad application in the detection of terrorist activities such as missile attacks on U.S. troops. Scientists at the Center for Quantum Devices (CQD) have demonstrated, for the first time, uncooled infrared imaging using type-II superlattice technology. This significant development could lead to smaller, faster and less expensive hand-held infrared imaging devices.

High-speed infrared (IR) imagers are capable of sensing thermal profiles of missiles and other objects that emit heat above that of the background. These devices also have potential in medical applications where excessive heating or cooling in the body can indicate trouble, such as inflammation, circulation issues or even cancerous tissue.

“For most practical applications, high-speed operation with handheld portability is especially important,” said CQD director Manijeh Razeghi, who led the research team. “Uncooled imagers are capable of handheld operation, which is critical in situations with soldiers on the battlefield or with firefighters in a smoke-filled environment. Cooled sensors, on the other hand, typically utilize liquid nitrogen for cooling to minus 200 degrees Celsius, making the sensors expensive and bulky.”

Type-II superlattices were first proposed by Nobel laureate Leo Esaki in 1973 and were then proposed for use in infrared detection in 1977. It wasn’t until semiconductor epitaxial growth techniques such as molecular beam epitaxy were sufficiently advanced in the 1990s, however, that high-performance infrared photon detection was fully demonstrated.

Currently, silicon microbolometer sensors, which operate on a thermal response principle -- as opposed to photonic response -- are capable of operating at room temperature but are orders of magnitude slower than photon detectors. Photon detectors detect light at infrared wavelengths and convert it directly to an electrical signal, whereas thermal detectors are physically heated by the infrared signal, which changes the resistance of the detector element creating a varying electrical signal, and is a much slower process. Thus type-II superlattices, which are photon detectors, are far more suitable for many applications requiring high-speed operation, such as missile detection.

With a strong program in photonic III-V material growth, device fabrication and development, CQD researchers were the first to demonstrate an imaging type-II superlattice focal plane array, and were also the first to demonstrate uncooled photo detection using type-II superlattice structures.

Recently CQD researchers have demonstrated an uncooled 256 by 256 pixel camera using an InAs/GaSb type-II superlattice, which can detect variations in temperature on the surface of a hot soldering iron while operating at room temperature (with a cutoff wavelength of 5 microns).

“The type-II superlattice will become the next generation infrared material replacing mercury cadmium telluride, or MCT,” said Razeghi, who is Walter P. Murphy Professor of Electrical and Computer Engineering. “MCT has many limitations, especially in the longer wavelength infrared range critical for missile detection, and we have demonstrated type-II detectors from three all the way up to 32 microns.”

Razeghi’s research group has been in very active pursuit of uncooled infrared photon detection. In their work, the researchers fabricated the focal plane arrays using the superlattice materials grown with an Intevac Mod Gen II solid-source molecular beam epitaxy system. At room temperature, the detectivity (the unit of measure to compare detector performance) was around 109 cm·Hz1/2/W.

The work performed at CQD has generated much interest in type-II superlattice research and has brought funding from the U.S. Missile Defense Agency, U.S. Air Force Research Laboratory, Office of Naval Research and Defense Advanced Research Projects Agency, as well as collaborations with Rockwell Scientific Company, Naval Research Laboratory, Jet Propulsion Laboratory and Raytheon Company.