Diagram Showing The Invention's Ultrafast Detection Scheme Based On The Plasmon-thermoelectric Effect.

New method offers low-cost, uncooled multi-spectral IR detection and imaging in the 8-12 µm bands

UCF researchers have invented a low-cost method that can enable ultrafast, tunable mid-IR detection and imaging without the need for expensive and complex cryogenic cooling. The novel graphene-based method paves the way for multi-spectral imaging in the mid-IR domain, which is not available in current technologies. Companies can use the invention for IR detection and imaging in the 3-5 µm range band and the 8-12 µm band for areas such as space exploration, spectroscopy, chemical/biological identification, short-range communication and remote sensing.

Current mid-IR detection and imaging systems (both cooled and uncooled) have drawbacks. For example, cooled IR detectors can achieve the high sensitivity needed to detect mid-IR photons, but they require expensive cryogenic cooling to do so. Uncooled detectors are more cost-effective, but they suffer from low sensitivity, slow response time, and require tedious, multi-step complex lithographic processes. More importantly, both types of mid-IR detectors today lack frequency tunability, since they are all single pixel (bucket) detectors that generate an integrated signal. This results in a loss of multi-spectral IR detection and imaging information. The UCF invention overcomes all of these drawbacks and limitations.

Technical Details

The new method provides tunable, uncooled mid-IR detection and imaging capabilities with microsecond response times. The nanoimprinting-based large-area patterning technique increases monolayer graphene mid-IR absorption to more than 60 percent by using a unique plasmon-assisted photothermoelectric effect. In one example application, a dielectric slab is sandwiched between an asymmetrically nanopatterned, partially perforated graphene layer, a nanostructured graphene sheet coupled with an optical cavity, and a back reflector. A process of asymmetrically heating the partially patterned graphene sheet leads to a directly measurable thermoelectric voltage. Infrared illumination is within the 3-5 µm and 8-12 µm bands.

Stage of Development

Prototype available

Benefits

• Uncooled infrared detection
• Electrostatically tunable
• Tunable absorption bandwidth

Applications

Uncooled, long-wave infrared detectors

Technology #33901

• Provisional Patent Application Filed

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