Graphene phototransistor provides up to 40 percent change in channel conductance for spectral sensing and situational awareness applications.

Currently, there are no fast, highly sensitive graphene-based photo detectors with a narrow but broadly tunable bandwidth for spectral sensing and situational awareness applications. Extensive effort has been made in this direction through the development of photodetectors based on tunable plasmon resonances in the two-dimensional electron gas (2DEG) of grating-gated high electron mobility transistors (HEMTs). However, a major limitation of these traditional 2DEGs is the requirement of a cryogenic operating temperature (less than –250 °F) to achieve sharp resonances and to observe resonant electrical effects.

UCF researchers have invented a graphene phototransistor providing a narrowband photo-response that is broadly tunable over a wide frequency range. The detector can be adapted to produce tunable phototransistors operable in the spectral range from ultraviolet (UV) to mm-waves, as well as the entire infrared and THz region. This mechanism is based on resonant gating of graphene by the concentrated, dynamic electric fields of surface plasmon polaritons (SPPs) and it forms the basis for tunable, high-speed imaging arrays.

Technical Details

Within the graphene phototransistor, photodetection occurs through an innovative combination of two transduction steps. 1) Incident photons are instantly converted with high efficiency to SPP’s. 2) The SPP fields produce a measurable perturbation on graphene transport, where high speed is anticipated due to graphene’s high room-temperature carrier mobility and by potentially light-like speeds for information transfer via SPP propagation.

The graphene sheet is positioned at the surface of a suitable photon-to-SPP excitation coupler. The SPP’s are excited at a specific angle of incidence for a given wavelength. The intense SPP fields, in turn, penetrate, gate, dynamically dope, and excite traveling waves of charge density in the graphene, causing changes in its conductance by a variety of potential mechanisms that are sensed electrically.

Benefits

• Up to 40 percent change in channel conductance
• Faster, greater sensitivity in light detection

Applications

• Spectral sensing
• Situational awareness

Technology #33098

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