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Title:Indirect modulation of a terahertz quantum cascade laser using gate tunable graphene

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Abstract:We bring together two areas of terahertz (THz) technology that have benefited from recent advancements in research, i.e., graphene, a material that has plasmonic resonances in the THz frequency, and quantum cascade lasers (QCLs), a compact electrically driven unipolar source of THz radiation. We demonstrate the use of single-layer large-area graphene to indirectly modulate a THz QCL operating at 2.0 THz. By tuning the Fermi level of the graphene via a capacitively coupled backgate voltage, the optical conductivity and, hence, the THz transmission can be varied. We show that, by changing the pulsing frequency of the backgate, the THz transmission can be altered. We also show that, by varying the pulsing frequency of the backgate from tens of Hz to a few kHz, the amplitude-modulated THz signal can be switched by 15% from a low state to a high state.

Number of references:0

Inspec controlled terms:Fermi level - Fermi resonance - graphene - optical conductivity - optical modulation - plasmonics - quantum cascade lasers - terahertz wave spectra

Uncontrolled terms:terahertz quantum cascade laser - indirect modulation - gate tunable graphene - terahertz technology - plasmonic resonances - THz frequency - compact electrically driven unipolar source - THz radiation - single-layer large-area graphene - Fermi level tuning - capacitively coupled backgate voltage - optical conductivity - THz transmission - pulsing frequency - amplitude-modulated THz signal - frequency 2.0 THz - C

Inspec classification codes:A4255P Lasing action in semiconductors - A4260B Design of specific laser systems - A4260F Laser beam modulation, pulsing and switching; mode locking and tuning - A7870G Microwave and radiofrequency interactions with condensed matter - A7320M Collective excitations (surface states) - A7820D Optical constants and parameters (condensed matter) -

A7830J Infrared and Raman spectra in organic crystals - B4320J Semiconductor lasers - B4330B  
Laser beam modulation, pulsing and switching; mode locking and tuning  
Numerical data indexing:frequency 2.0E+12 Hz  
Chemical indexing:C  
Treatment:Experimental (EXP)  
Discipline:Physics (A); Electrical/Electronic engineering (B)  
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