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Multifunctional graphene metadevice using dual metamaterial induced transparency in terahertz regime

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Highlights

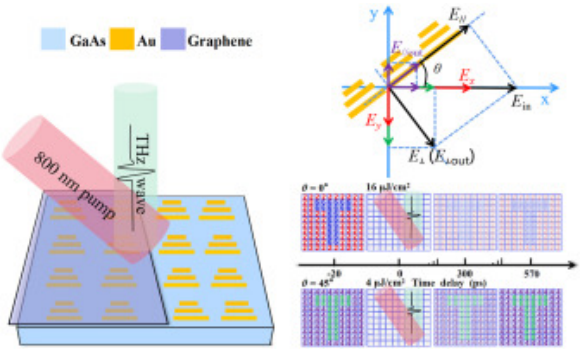
- Spectral modulation of dual metamaterial induced transparency in hybrid structures.
- Controllable manipulation of the phase, group delay, and ploarization conversion.
- Switch power of dual-MIT is reduced by 4 times with the introduction of graphene.
- Ultrafast all-optical switch possessing 2-time enhancement in modulation speed.
- Encrypted imaging about the erasure and reappearance of the target pattern.

Abstract

The dual metamaterial induced transparency (dual-MIT) phenomenon, which can be significantly tailored via the depolarization field effect of the graphene overlayer, is demonstrated in our fabricated multifunctional terahertz metastructures composed of unequal-lengthed 3-bar arrays. Those metasurfaces could actively manipulate the phase and group delay at various frequencies, as well as the different polarization conversion capability. The introduction of graphene reinforces the amplitude modulation of

dual MITs and further reduces the quenched power by 4 times with a rotated angle. Combined with carrier dynamics, the dual-MIT transient regulation can realize an ultrafast all-optical switch with 2-time enhancement in modulation speed. Based on the advantage of the dual-MIT windows with different frequencies and magnitudes, we have illustrated the encrypted imaging on the erasure and reappearance of the target pattern. Our work provides a lower power consumption option for ultrafast all-optical switch and opens up the opportunities for future communication and information security in terahertz regime.

Graphical abstract



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Keywords

Terahertz; Multifunctional device; Graphene; Metamaterial induced transparency

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