THz Self-induced Actions on a Graphene Based Thin Film Absorber

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The era of terahertz (THz) wireless communication opens ahead revealing the high importance of the development of fast modulation devices operating at the THz part of the electromagnetic spectrum. Towards this direction many devices based on graphene have been proposed to modulate radiation at THz frequencies [1,2]. Here, we demonstrate a graphene-based THz perfect absorber based on a cavity of monolayer graphene over a grounded dielectric that can be self-modulated using intense THz fields.

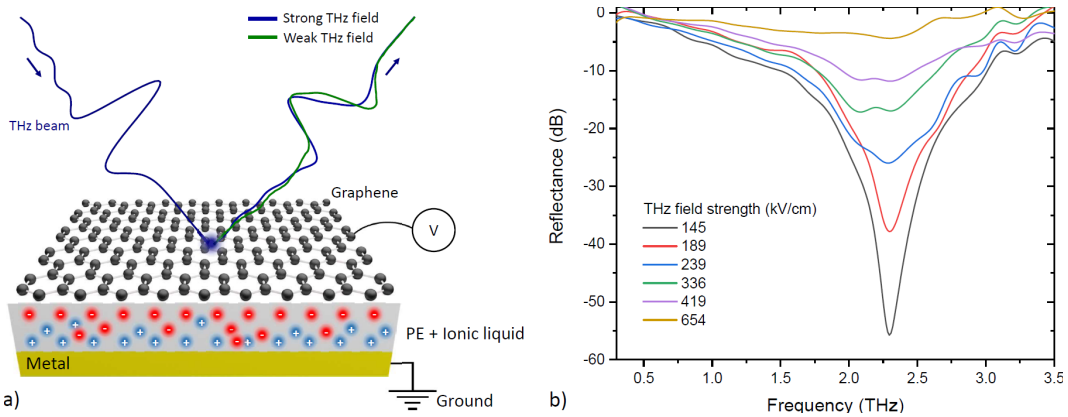

FIg. 1: (a) Schematic representation of the device. (b) Reflection spectra for various incident THz field strengths.

The cavity (Fig. 1a) is formed by a 25 μm thick, porous membrane sandwiched between a monolayer graphene and a gold electrode. The porous membrane was soaked with room-temperature ionic liquid electrolyte that allowed us to fine tune the Fermi energy of graphene with an external gating. For the excitation of the device a high-power THz source based on two-color filamentation was used, providing THz pulses with peak electric field strengths reaching 700 kV/cm. At low THz field strengths, the device achieves an absorption of -56 dB at 2.3 THz that drops to -4 dB for high field strengths (Fig. 1b). Detailed theoretical analysis indicates that the origin of the THz nonlinear response is the THz induced heating of the graphene's carriers, that leads to a reduction of its conductivity, and consequently to reduced absorption of the THz radiation. Our results can find applications in future dynamically controlled flat optics and spatiotemporal shaping of intense THz electric fields.

References

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