Graphene field-effect transistors as room-temperature Terahertz photodetectors

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Graphene is nowadays attracting considerable attention for a variety of photonic applications, including fast photodetectors, transparent electrodes in displays and photovoltaic modules, and saturable absorbers [1]. Owing to its gapless spectrum and frequency-independent absorption coefficient, it has been recognized as a very promising element for the development of detectors and modulators operating in the Terahertz region of the electromagnetic spectrum (wavelengths in the hundred □m range), which is still severely lacking in terms of solid-state devices. We report the realization of THz detectors based on antenna-coupled single-layer and bilayer graphene field-effect transistors (FETs). The photodetection mechanism originates from the non-linearity of the FET response to the oscillating radiation field at the top gate electrode leading to a photoresponse proportional to the derivative of the conductance as a function of the gate voltage [2]. By analyzing the photoresponse at different chopping frequencies of the incident radiation we also identify an additional slower contribution. We ascribe this to a competing thermoelectric effect originating from the difference in the thermal diffusions of carriers in the p/n parts of the graphene junction defined by the top gate [3]. Already in this first implementation, room temperature operation at 0.3 THz is achieved, with promising noise equivalent powers of ≈ 10 nW/(Hz)$^{1/2}$.

References

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[3] N.M. Gabor et al. Science **334**, 648 (2011)