Photons, Plasmons and Electrons meet in 2d materials

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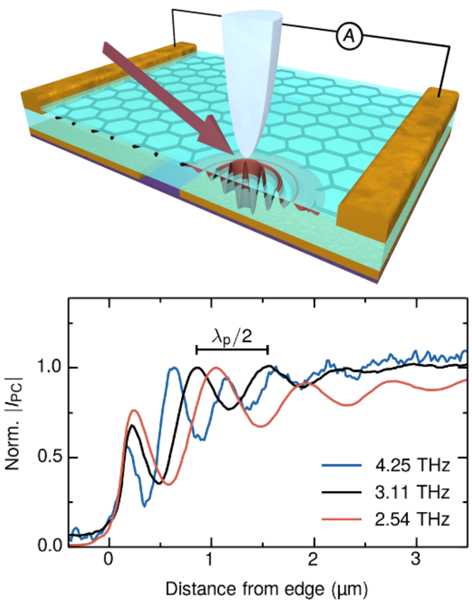
The optoelectronic response of two-dimensional (2D) crystals, such as graphene and transition metal dichalcogenides (TMDs), is currently subject to intensive investigations. Owing to its gapless character, extraordinary nano-photonic properties and ultrafast carrier dynamics [3], graphene is a promising material for nano-optoelectronics and high-speed photodetectors [4], whereas TMDs have emerged as potential candidates for sensitive photodetection thanks to their enhanced photon absorption [1]. Vertically assembling these crystals in so-called van der Waals heterostructures allows the creation of novel and versatile optoelectronic devices that combine the complementary properties of their constituent materials.

Here we present a various new device capabilities, varying from nano-photonic devices to ultra-fast and broadband electrical detectors. We applied femtosecond time-resolved photocurrent measurements on 2d material heterostructures, which probes the transit of photoexcited charges across the photoactive TMD layer – and thus current generation – directly in the time domain [2]. In addition, we apply for the first time infrared photocurrent nanoscopy [4] to high-quality graphene devices. We image the plasmon-voltage conversion in real space, where a single graphene sheet serves simultaneously as the plasmonic medium and detector for both infrared and THz frequencies [6,7].



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