

Terahertz optoelectronics in novel low-dimensional narrow gap semiconductor nanostructures

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The terahertz regime belongs to the least explored one in the electromagnetic spectrum but promises a wide range of applications in material characterization, product inspection, imaging or medical imaging, to name a few. Besides optimizing existing concepts, the advent of novel materials like graphene or topological insulators which are gapless or feature a small gap comparable to the energy of THz radiation offers new opportunities to look for novel and sensitive detectors. Such detectors and detector systems, which can be used, e.g., for imaging spectroscopy are an indispensable ingredient of THz technology. Apart from the practical side the basic physics connected to these novel materials is interesting in its own and deserves special attention. The key material explored in this project is HgTe (and related compounds), both in two-dimensional and three-dimensional form. Depending of the thickness of the HgTe film (quantum well) the material is either a conventional narrow-gap semiconductor, already used for infrared detection, or a topological insulator with gapless edge modes. Within this project, it is planned to explore with this material basis the physics of the recently in GaAs observed giant photoconductivity effect occurring at a quantum point contact under THz irradiation. Another promising system to explore THz-matter interaction are ratchets based on low dimensional semiconductors/topological insulators with superimposed lateral superlattices.

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