GRK 2905
Ultrafast
Nanoscopy

Colloquium

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RUN Auditorium

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Infrared near-field spectroscopy of few-layer graphene

Infrared scattering-type scanning-near-field optical microscopy (s-SNOM) enables the imaging of nanostructures with sub-diffraction resolution by elastic light scattering at a sharp tip. s-SNOM also boosted the field of 2D materials by enabling real-space imaging of plasmon- or phonon polaritons, e.g., in graphene and hexagonal Boron Nitride (hBN), respectively. Polariton imaging with s-SNOM has allowed for indirectly mapping (grain) boundaries and (stacking) defects in few-layer Graphene (FLG) via polariton reflection.
Here, I will present how spectroscopic IR s-SNOM is able to determine the local stacking order at nanoscale resolution not only of bare few-layer graphene, but also when it is encapsulated below hBN layers. I will explain the contrast mechanisms, mainly based on the characteristic and stacking-dependent interband transitions of FLG, for bilayer graphene, trilayer (TLG) graphene and tetralayer graphene (4LG). We retrieve and reconstruct these characteristic complex optical conductivity resonances from the amplitude and phase of the scattered light, which e.g. allow for the unambiguous assignment of previously undetected ABCB domains in 4LG.
Coupling the (stacking-dependent) FLG with phonon polaritons in a hBN TLG heterostructure also leads to coupled polaritons (hyperbolic phonon plasmon polaritons). We explore how they allow for super-resolution imaging of subdiffraction-sized defects in graphene through the hBN cover layer via the so-called hyperlensing effect. Furthermore, we show how resonators for polaritons in 2D materials like hBN can be easily fabricated and optically reconfigured using Phase-Change Materials.