Nano-optics of 2D Heterostructures by synchrotron infrared nanospectroscopy

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Light-matter interaction in 2D photonic materials allows for confinement and control of free-space radiation on sub-wavelength scales. Most notably, the van der Waals photonic heterostructures obtained by stacking graphene and polar 2D materials can provide for hybrid materials with enhanced opto-vibrational properties. Most of polar materials have vibrational activity in the mid-IR range (7.5 μm to 12.5 μm wavelengths) and is not spatially accessible for conventional IR spectromicroscopy (μ-FTIR) due to the Abbe limit. Alternatively, broadband synchrotron IR nano-spectroscopy (nano-FTIR) is quickly becoming a standard tool inside synchrotron facilities which benefits studies in the theme of nano-optics and nano-chemistry of materials. Combining the ultra-broadband IR beam from storage rings with the sub-diffractional light confinement of scattering near-field optical microscopy (s-SNOM), nano-FTIR is a technique that explores the chemical and label-free specificity of the IR spectroscopy with the ultra-resolved optical probe of the s-SNOM, allowing opto-vibrational investigations with spatial resolution of c.a. 25 nm.

This talk will bring a quick overview on synchrotron nano-FTIR technique as well as it will expose the application of nano-FTIR in the study of light confinement in atomically thin nanomaterials. Among the various materials to be approached, the talk will highlight recent results on hybrid plasmon-phonon polaritons transport in a passive nano-optical diode junction in graphene-hBN 2D structures.