Infrared nano-imaging and spectroscopy on graphene using scattering-type SNOM

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First visualisation and analysis of Dirac plasmons propagating along graphene was realized using the neaSNOM infrared near-field microscope [1, 2] in 2012. Ever since this s-SNOM instrument has routinely been applied for graphene plasmon interference mapping that allows the extraction of local material properties, e.g. conductivity, intrinsic doping and defects. Direct control of propagating surface plasmons on graphene with resonant antennas and conductivity patterns has also been demonstrated using the neaSNOM technology [3, 4].

Additionally, the highly flexible design of the neaSNOM microscope enables a complete new level of correlation microscopy: near-field microscopy in combination with time-resolved measurements [5].

In this presentation, some recent examples of application of the neaSNOM used for graphene research are shown. Carrier relaxation in heterostructures in high-purity graphene [6] as well as photocurrent measurements on graphene will be reviewed [4, 7].

With more than 30 high impact articles published in the last few years on the 'flatland optics', the neaSNOM is the best tool for nanoscale imaging and spectroscopy on graphene.

Furthermore, a technological breakthrough in the field of near-field optics has been achieved with cryogenic near-field imaging and spectroscopy, pioneered by the group of Dimitri Basov [9]. With the new cryo-neaSNOM we extend ambient near-field measurements to the cryogenic temperature range (<10-300 Kelvin) and open a complete new world for nanoscale optical microscopy and spectroscopy [Figure 1]. This technology enables for example the direct mapping of phase-transitions in strongly correlated materials or the detection of low-energy elementary excitations at the surface of solid-state systems.

References

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Figures

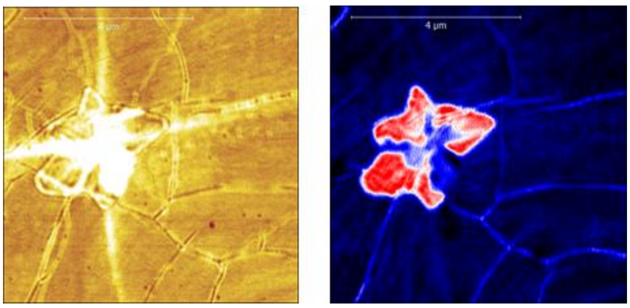

Figure 1: cryo-neaSNOM images of graphene at 8.5 K: a) optical amplitude; b) optical phase.