SFB1242

SFB 1242 Nichtgleichgewichtsdynamik kondensierter Materie in der Zeitdomäne

UNIVERSITÄT DUISBURG ESSEN

Open-Minded

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High-resolution phonon polariton mapping in real and momentum space

Dr. Alexander Paarmann

Fritz Haber Institute of the Max Planck Society, Berlin, Germany

Surface phonon polaritons, light-matter coupled waves at the interface between a dielectric and a polar crystal, have recently attracted much attention as a versatile tool for low-loss nanophotonic applications in a range spanning from mid- to far-infrared [1]. These modes exist inside the Reststrahlendband, i.e. the region included between the two resonance frequencies of transverse and longitudinal optical phonons where the dielectric permittivity is negative. In my talk, I will demonstrate two different experimental approaches of mapping phonon polaritons in real and momentum space, respectively.

In the real space approach, I will show our recent development of wide-field sum-frequency generation (SFG) microscopy as a new infrared super-resolution imaging technique. By combining a resonant infrared and non-resonant visible light beam at an interface, a light field at the sum of the two incoming frequencies is generated. The emerging SFG signal can be imaged with a resolution limit given by its visible wavelength, i.e. well below the diffraction limit of the resonant infrared wavelengths. We use our SFG microscope to image localized surface phonon polaritons in sub- diffractional nanostructures, accessing the mode profiles on their natural, sub-diffractional length scales [2]. In a complementary approach, momentum-space polariton mapping is achieved by Otto-type prism coupling. Here, the evanescent waves at the back side of the prism illuminated in total internal reflection are coupled to surface polaritons with precisely controlled momentum and efficiency [3]. I will show how we used this technique to reveal a novel type of surface polaritons – hyperbolic shear polaritons – that emerge in low-symmetry monoclinic crystals [4]. These modes feature novel properties such as continuous rotation of their propagation direction with frequency as well as asymmetric propagation patterns. Our prism coupling experiment enabled us to map out the azimuthal dependence of the energy-momentum dispersion of these modes, experimentally verifying the novel properties of the shear polaritons.

[1] J. D. Caldwell et al, Nanophotonics **4**, 1 (2015).
[2] R. Niemann et al., Appl. Phys. Lett. **120**, 131102 (2022).
[3] N. C. Passler, et al., ACS Photonics **4**, 1048–1053 (2017).
[4] N. C. Passler et al., Nature **602**, 595 (2022).

Für diese Zeit steht eine Kinderbetreuung nach vorheriger Anmeldung zur Verfügung.

Contact: Prof. Dr. Björn Sothmann, Faculty of Physics
Phone: +49 (203) 37-93330 / Mail: bjoerns@thp.uni-due.de