O 83: Poster Session VI: Poster to Mini-Symposium: Infrared nano-optics IV

Time: Wednesday 13:30–15:30 Location: P

O 83.1 Wed 13:30 P

Dipole model for far-field thermal emission of a nanoparticle above a planar substrate — •Florian Herz and Svend-Age Biehs — Institut für Physik, Carl von Ossietzky Universität, D-26111 Oldenburg, Germany

I will present our latest efforts in developing a dipole model describing the thermal far-field radiation of a nanoparticle close to a substrate. The nanoparticle serves as a first approximation for the cantilever tip usually used in infrared near-field thermal imaging experiments [1-3].

We generalized existing approaches by including the possibility to have different temperatures for substrate, nanoparticle, and background to cover setups like the thermal radiation scanning tunnelling microscope (TRSTM) [1], the thermal infrared near-field spectroscopy (TINS) [2], and the scanning noise microscope (SNoiM) [3]. Apart from the induced electric dipole moment, we also considered eddy currents being particularly important for metallic particles. Furthermore, instead of neglecting divergent terms of the Green's function appearing in the dipole model, we carry out a renormalization procedure.

I will explain how we methodically incorporated these generalizations and discuss how they affect the numerical simulations. Additionally, I will discuss the impact of parameters like particle size and emission angle as well as the distance dependence for all four combinations of the materials gold and SiC for nanoparticle and substrate.

1 Y. De Wilde et al., Nature 444, 740 (2006)
2 A. C. Jones and M. B. Raschke, Nano. Lett. 12, 1475 (2012)
3 Q. Weng et al., Science 360, 775 (2018)

O 83.2 Wed 13:30 P

Nanoimaging of vibrational strong coupling between propagating phonon polaritons and organic molecules — •A Bylinkin[1,2], M Schnell[1], M Autore[1], F Calavalle[1], P Li[1], J Taboada-Gutierrez[3], S Liu[4], J Edgar[4], F Casanova[1], L Hueso[1], P Gonzalez[3], A Nikitin[2], and R Hillenbrand[1] — [1]CIC nanoGUNE BRTA, Spain — [2]DIPC, Spain — [3]Universidad de Oviedo, Spain — [4]Kansas State University Manhattan, USA

Enhanced light-matter interaction in polar crystals attracts considerable attention since the latter support phonon polaritons (PPs) - hybrid electromagnetic modes involving atomic vibrations. PPs in the thin slab of van de Waals materials (vdW) demonstrate long lifetime and ultra-high field confinement which can lead to intriguing vibrational strong coupling (VSC) phenomena and potential sensing applications. Recently VSC between h-BN nano-resonators and molecular vibration has been demonstrated. However, the basic interaction between molecular vibrations and propagating PPs in unstructured slabs of the vdW materials has not yet studied. In this work, we use nanoimaging techniques to study the interaction between propagating h-BN PPs and organic molecular vibrations. We performed near-field polariton interferometry, showing that VSC leads to the formation of a hybrid mode with a pronounced anti-crossing region in its dispersion. Our work shows the fundamental study of the strong-coupling between molecular vibration and propagating PPs.

O 83.3 Wed 13:30 P

Nonlocal response of polar dielectric systems — Christopher Gubbin and •Simone De Liberato — School of Physics and Astronomy, University of Southampton, Southampton, United Kingdom

Surface phonon polaritons hosted in polar nanostructures are fast becoming a leading platform for mid-infrared nanophotonics, permitting deep sub-diffraction energy localisation in comparatively low-loss modes. Recent experiments have demonstrated that as polar resonators approach the nanoscale their optical response diverges from that predicted using a local dielectric model [1, 2]. Although this divergence can be explained by microscopic ab-initio methods it is impractical to apply these intensive calculations to optical systems. To solve this issue we develop a nonlocal dielectric theory which captures the essence of the material response by accounting for propagating phonon modes in the dielectric. Unlike in plasmonic nonlocality these modes can propagate into the host medium, yielding a discrete spectrum and unique phenomenology. In this talk I outline our theory [3], its applications to nanoscale polar resonators [4] and superlattices [5], and finally discuss some of the predicted features, including the impact on the resonator spectral response and quality factor.

[1] D. C. Ratchford et al., ACS Nano 13, 6730 (2019).
[2] C. R. Gubbin et al., Nat. Comm. 10, 1682 (2019).
[3] C. R. Gubbin et al., Phys. Rev. X 10, 021027 (2020).
[4] C. R. Gubbin et al., Phys. Rev. B 102, 201302(R) (2020)
[5] C. R. Gubbin et al., Phys. Rev. B 102, 235301 (2020)