DS 15: Focussed Session: Frontiers in Exploring and Applying Plasmonic Systems I (Joint Session of CPP, DS, HL, MM, and O, organized by DS)

With the increasing importance of plasmonics and the variety of its number of applications it becomes obvious that experimental characterization beyond the far-field optical standard methods and also theoretical tools that access the plasmonic behaviour on the atomic scale are indispensable for further development and improvement of the basic knowledge and thus, for new kinds of applications. The "Focused Session" gathers experts for unusual experimental methods (near-field studies with SNOM and EEL-TEM) and for the theoretical exploration of quantum effects in plasmonic excitations. Furthermore, new kinds of plasmonic applications (devices exploiting phase changes, alternative displays and holograms) will be introduced.

Organizers: Laura NaLiu (U Heidelberg) and Annemarie Pucci (U Heidelberg)

Time: Monday 16:30–17:15 Location: CHE 89

DS 15.1 Mon 16:30 CHE 89

Strong Coupling between Phonon-Polaritons and Plasmonic Nanorods — •Christian Huck[1], Jochen Vogt[1], Tomáš Neuman[2], Tadaaki Nagao[3], Rainer Hillenbrand[4,5], Javier Aizpurua[2], Annemarie Pucci[1], and Frank Neubrech[1,6] — [1]Kirchhoff Institute for Physics, Heidelberg, Germany — [2]Materials Physics Center (CSIC-UPV/EHU) and Donostia International Physics Center (DIPC), Donostia-San Sebastián, Spain — [3]WPI Center for Materials NanoArchitectonics, National Institute for Materials Science, Tsukuba, Japan — [4]CIC nanoGUNE and UPV/EHU, Donostia-San Sebastián, Spain — [5]IKERBASQUE, Basque Foundation for Science, Bilbao, Spain — [6]4th Physics Institute, Stuttgart, Germany

We perform far-field spectroscopy of metal nanoantennas, resonant in the infrared spectral region, placed on silicon oxide (SiO_2) layers of different thickness. Due to strong coupling between the plasmonic excitation of the metal antenna plasmons and the surface phonon-polaritons of thin SiO_2 layers a splitting of the plasmonic resonance is found in the respective spectra. Although the phonon-polaritons themselves are dark excitations under normal illumination, they strongly interact with plasmon-polaritons as we detailed for a planar SiO_2 layer beneath the nanostructures. The observed splitting can result in a transparency window, corresponding to suppression of antenna scattering, respectively "cloaking" of the antenna. The effect is a kind of induced transparency in which the strength of the phonon-polariton field plays the crucial role. It represents a further tuning possibility for the optical performance of infrared devices.

DS 15.2 Mon 16:45 CHE 89

Enhanced Infrared Spectroscopy of Single Small Fine Dust Particles with Resonant Plasmonic Nanoslits — •Jochen Vogt[1], Sören Zimmermann[2], Christian Huck[1], Michael Tzschoppe[1], Frank Neubrech[1,3], Sergej Fatikow[2], and Annemarie Pucci[1] — [1]Kirchhoff Institute for Physics, Heidelberg University, Heidelberg, Germany — [2]Division Microrobotics and Control Engineering, University of Oldenburg, Oldenburg, Germany — [3]4th Physics Institute, University of Stuttgart, Stuttgart, Germany

Guiding the way towards dust sensing devices based on surface-enhanced infrared (IR) absorption (SEIRA), our study demonstrates the potential of plasmonic nanostructures for chemically specific identification of single tiny fine dust particles. The model system under investigation consists of individual silica spheres with diameters below 240 nm placed at defined positions in resonant plasmonic nanoslits. With dimensions far below the wavelength, direct IR spectroscopic measurements of such particles are not possible in reasonable time scales. In our SEIRA setup, the characteristic phononic particle excitations of the silica spheres are enhanced by the strong near-field of the plasmonic nanoslits, which enables the IR spectroscopic identification of individual particles. The SEIRA signal enhancement of single particles at various positions along the nanoslit structure fully corresponds to the near-field enhancement profile of these structures with the optimal position for SEIRA sensing to be located at sites towards the slit middle.

DS 15.3 Mon 17:00 CHE 89

Transverse and Longitudinal Resonances in Plasmonic Gold Tapers — Surong Guo[1], Nahid Talebi[1], Wilfried Sigle[1], Ralf Vogelgesang[2], Gunther Richter[3], Martin Esmann[2], Simon F. Becker[2], Christoph Lienau[2], and •Peter A. van Aken[1] — [1]Max Planck Institute for Solid State Research, Stuttgart, Germany — [2]Carl von Ossietzky University of Oldenburg, Oldenburg, Germany — [3]Max Planck Institute for Intelligent Systems, Stuttgart, Germany

Conically-shaped metallic tapers are one of the most common structures with concomitant capabilities of nanofocusing and field enhancement. We distinguish two different dynamic mechanisms, reflection and phase matching, of surface plasmons excited by relativistic electrons in three-dimensional gold tapers with various opening angles from 5° to 47° which are studied both experimentally and theoretically, by means of electron energy-loss spectroscopy and finite-difference time-domain numerical calculations, respectively. We observe distinct resonances along the taper shaft independent of opening angles. We show that the origin of these resonances is different at different opening angles and results from a competition between two coexisting mechanisms. For large opening angles ($> 20°$), phase matching between the electron field and that of higher-order angular momentum modes is the dominant contribution because of the increasing interaction length between electron and the taper near-field. In contrast, reflection from the taper apex dominates at small opening angles ($< 10°$). A gradual transition of these two mechanisms is observed for intermediate opening angles.