PCSI
Room Ballroom South - Session PCSI-1MoM
2D Plasmonics

Moderator: Anders Mikkelsen, Lund University, Sweden

8:30am **PCSI-1MoM-1 Controlling Light at the Atomic Scale with 2D Polaritons***, **Javier García de Abajo**,* ICFO-Institut de Ciencies Fotoniques, Av. Carl F. Gauss 3, 08860 Castelldefels (Barcelona), Spain **INVITED**

Two-dimensional materials have been recently shown to host robust polaritonic modes, ranging from plasmons in highly doped graphene to excitions in transition metal dichalcogenides. The electromagnetic behavior of these modes can be well understood in terms of an effective surface conductivity, in which we can capture their strong dependence on temperature and external static electric and magnetic fields. In this talk, I will overview the general characteristics of the optical response of these materials, which we can understand in terms of simple theoretical descriptions. We will also cover more sophisticated descriptions, aiming at exploring genuinely quantum-mechanical effects. We will further overview recent advances in ultrafast optical response and nonlinear optics, as well as the potential application of these materials for quantum-optics and optical sensing.

9:05am **PCSI-1MoM-8 An Optical transformer-based Campanile Near-field Probe on an AFM Cantilever***, K Le,* aBeam Technologies*; S Bilent,* Lawrence Berkeley National Lab*; C Pina-Hernandez,* aBeam Technologies*; S Cabrini,* Lawrence Berkeley National Lab*; **Keiko Munechika**,* aBeam Technologies

Near-field scanning optical microscopy (NSOM) is a powerful and unique approach to characterize the chemical, physical and biochemical properties of materials with the nanometer scale resolution in real-time. NSOM has so far played only a niche role as characterization technique due to one main bottleneck: The need of reliable, efficient, and broadband near-field probes. An optical transformer-based Campanile near-field probes are a novel class of nano-optical tips, which proved to operate extremely reliably, can be employed by non-experts, are completely independent of the substrate type, and combine superior performance in terms of spatial resolution, near-field enhancement, bandwidth, and signal to noise ratio. Since the invention of the probes, the tips have been successfully used for multidimensional spectroscopic imaging of nanostructures with nanoscale resolution, providing so far in-accessible insights into optoelectronic process. The original probes are fabricated on top of an optical fiber. Our aim is to develop the fabrication technology to incorporate the Campanile optical transformer into a standard atomic force microscopy (AFM) platform as a novel class of NSOM probes.

We report a realization of Campanile near-field scanning optical probe on an AFM platform. The fabrication process was based on standard micro-lithography techniques allowing a straightforward production of multiple cantilevers on a wafer scale. Figure 1 shows a scanning electron micrograph (SEM) image of an optical transformer on a cantilever. The measured resonance frequencies of the AFM cantilevers are in excellent agreement with theoretical calculations over different cantilevers as shown in Figure 2, which justifies our characterization. This work paves the way for low cost and reproducible manufacturing of near-field probes suitable for high-resolution hyperspectral imaging.

9:10am **PCSI-1MoM-9 Localized Surface Curvature Artifacts in Gap-mode Tip-enhanced Nanospectroscopy***, **Darya Stepanichsheva**,* Tomsk Polytechnic University, Russia

Tip-enhanced Raman spectroscopy (TERS) allows for chemical analysis to exceed the limit of light diffraction and to reach nanoscale spatial resolution. The high-spatial sensitivity is provided by the metal substrate in the so-called gap-mode TERS. However, in this case, the connection between the tip and the sample could lead to distortions in the image of the nanostructure during visualization. The purpose of this work is to provide a generalized view of such image artifacts in TERS imaging and to find out whether these effects occur and to what extent. We used ultrathin molecular layers and self-assembly monolayers as Raman-active probes deposited on Au and Si films and Au nanostructures. In addition to the 6-fold amplification of the Raman signal, we found that the sample curvature in gap-mode induces imaging artifacts visible as distortions in the electromagnetic field distribution.

Our results show that the use of gap-mode significantly increases the signal strength, but that at the same time, the sample curvature makes an impact to the TERS image contrast which was not considered until now. Beyond metal nanoparticles functionalized with organic molecules, our conclusions impact the nanoscale chemical visualization of molecular and inorganic systems using vibrational spectroscopy.

* Author for correspondence: jane.sheremet@gmail.com

Author Index

Bold page numbers indicate presenter