New tools and concepts for nano-optics: combining photons and electrons

Mini-colloquium 16

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Nano-optics is a rapidly growing field of research that focuses on optical phenomena at the nanometer scale. The sub-wavelength optical properties of a system may not be accessed with far-field optical tools (excitation and detection with propagating light from the far-field) due to the diffraction limit of light. Thus, new tools and concepts for nano-optics have emerged. This includes many different techniques based on (i) near-field optical excitation and/or detection (Scanning Near-field Optical Microscopy, SNOM, Photon Scanning Tunneling Microscopy, PSTM), (ii) local electrical excitation with either tunneling electrons (Scanning Tunneling Microscopy, STM) or fast electrons (cathodoluminescence, CL, Electron Energy Loss Spectroscopy, EELS) and (iii) photoelectron detection (Photoemission Electron Microscopy, PEEM).[1, 2, 3, 4, 5] Such techniques have recently shown unrivaled capabilities for the investigation of plasmon and exciton physics at the nanometer scale.[6, 7, 8] When applied to nano-optics, the same challenges with respect to detection sensitivity, and spatial and spectral resolution must be resolved. Fundamental questions also arise regarding the physical interpretation of the acquired results, a crucial issue when considering these techniques as relevant nano-optics probes.[2, 9] Though these tools and concepts have been developed in different scientific communities (nearfield optics, solid state physics, materials and surface science...), they involve increasingly overlapping theoretical interpretations and fields of application; however, the benefits of comparing and combining them to enhance their capabilities have until now been much ignored. The goal of this mini-colloquium is therefore to foster a dialogue between these scientific communities and to highlight the latest experimental and theoretical results illustrating the impact of these novel approaches on nano-optics.

The mini-colloquium will both include an oral session, with 15’ regular and 30’ invited talks, and a poster session. Confirmed invited speakers: Prof. Javier García de Abajo (ICFO Barcelona) and Dr. Palash Bharadwaj (ETH Zürich).

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Figure 1: (a) Near-field photoluminescence microscopy image of a semiconducting single-walled carbon nanotube.[6] (b) Excitation of a gold Yagi-Uda nano-antenna with high-energy electrons in a scanning electron microscope (SEM) and a CL intensity map.[4] (c) Excitation of the surface plasmon polaritons (SPP) of a gold nanostripe with an STM tip.[7] (d) Dark-field scanning transmission electron micrograph (HAADF-STEM) and EELS amplitude map of a triangular silver nanopris.[10] (e) Probing nonlocal effects through EELS in metal nanoparticle dimers: calculated loss probability of a 200 keV electron passing near dimers formed by spherical gold particles of 20 nm in diameter.[2]

References