O 6: Symposium: Ultrafast Nanooptics I

Time: Monday 11:15–12:45 Location: H38

Invited Talk O 6.1 Mon 11:15 H38

A nanometer-sized femtosecond electron source — •Christoph Lienau[1,2], Claus Ropers[2], Daniel Solli[2], Claus Peter Schulz[2], and Thomas Elsaesser[2] — [1]Institut für Physik, Carl von Ossietzky Universität Oldenburg — [2]Max-Born-Institut, Berlin

Femtosecond electron and X-ray diffraction are currently among the most intriguing topics in ultrafast science, allowing for probing structural dynamics of molecular and solid state systems with previously unachievable temporal resolution. In electron diffraction, overcoming temporal smearing due to spatial propagation effects and to Coulomb repulsion of electron bunches produced at kHz repetition rates presents a considerable experimental challenge. Ultimately, therefore, a point-like source of single electrons with temporal resolution in the regime of few femtoseconds would be highly desirable.

In this paper, we describe and demonstrate a novel approach towards realizing such a point-like ultrafast electron source. By illuminating ultrasharp gold tips with 7-fs pulses from an 80 MHz Ti:sapphire oscillator, we induce emission of an intense flux of up to 10ˆ7 electrons per second. Due to the local field enhancement this emission is strongly localized at the apex of the metallic tip with a radius of curvature of only few tens of nanometers. We demonstrate the multiphoton character of the electron generation from a highly non-equilbrium electron distribution and report on quantitative measurements of the transient distribution function. The results of first imaging experiments using this novel electron source will be presented, demonstrating near-field imaging of local electric fields with sub-20 nm spatial resolution.

Invited Talk O 6.2 Mon 11:45 H38

Mastering optical near fields in nanostructured materials — •Javier Garcia de Abajo[1], Tobias Brixner[2], Walter Pfeiffer[3], and Christian Spindler[2] — [1]Instituto de Optica, CSIC, Serrano 121, 28006 Madrid, Spain — [2]2Physikalisches Institut, Universität Würzburg, Am Hubland, 97074 Würzburg, Germany — [3]Fakultät für Physik, Universität Bielefeld, Universitätsstr. 25, 33516 Bielefeld, Germany

The control of the flow of light at the nanoscale has attracted considerable interest over the past few years. Trully nanometer control is actually possible via localized states such as plasmons, which have given rise to the active field of plasmonics. Some basic properties of plasmons in nanoparticles and in nanopatterned surfaces will be reviewed in this talk. Phenomena such as plasmon hybridization, signal propagation, and extraordinary optical transmission will be discussed. Finally, energy transfer during interaction with ultrashort laser pulses will be considered and compared to the interaction of fast electrons with photonic nanostructures.

Invited Talk O 6.3 Mon 12:15 H38

Near-field second harmonic generation from single gold nanoparticles — •Giulio Cerullo, Michele Celebrano, Margherita Zavelani-Rossi, Paolo Biagioni, Marco Finazzi, and Lamberto Duò — Dipartimento di Fisica, Politecnico, Milano, Italy

Second-harmonic generation (SHG) from gold nanoparticles, both isolated and in high-density patterns, is investigated by a nonlinear scanning near-field optical microscope (SNOM). High peak power femtosecond polarized light pulses at the output of a hollow pyramid aperture allow efficient second-harmonic imaging, with sub-100-nm spatial resolution and high contrast. SHG on the nanoscale provides unique information on local field enhancement with respect to conventional linear SNOM and far-field microscopy. In particular, nanoscale SHG enhancement is shown to be very sensitive to localized surface plasmon resonances as well as to the morphology of the nanostructures. The combined analysis of linear and second harmonic SNOM images provides complementary information enabling to distinguish between near-field scattering, absorption and re-emission processes.