Physics Department seminar

DIPARTIMENTO DI FISICA, VIA CELORIA 16, MILANO

Aula Consiglio

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Nonlocality by Nanoconfinement.
How concurrent plasmonic assisted hot electrons and optical imaging spectroscopies reveal new phenomena at the nanoscale; the case of bidimensional heterojunctions

Understanding the intimate nature of matter with consequent development of new applications often moves from a significant technological advancement as, for example, the possibility of mapping light-matter interaction phenomena at space and time scales characteristic of electrons dynamics and interfaces interaction. Focusing on the control of optical phenomena at the nanoscale, Nanoplasmonics has brought to many fundamental scientific breakthroughs pushing to a new limit the knowledge and the control of the processes that rule optoelectronic devices, and life science, at the nanoscale. Here I focus on a novel plasmonic setup, the Hot Electron Nanoscopy and spectroscopy (HENs) instrument that enables to access topographical, structural, optical properties, and to carry out novel electrical transport investigations of the samples' surface at nano-scale, with high sensitivity and ultimate spatial resolution. Key to the study is the electro-mechanical nature of surface plasmon polaritons, SPPs, responsible for the highest local field enhancement, and their damping processes, which paved the way to multi-spectroscopic analysis of tiny amount of matter, down to the single molecule detection limit. Despite SPPs decay in energetic hot electrons, he-, is a process usually considered unfavorable, advantage is gained at tips and cusps of metallic nanostructures thanks to the diverging generation rate. At the tip, highly enhanced sub-diffraction limited localization of the electro-mechanic energy overcomes both limits, the fundamental optical diffraction, and the energy transport of electrons in the metal, offering nanometric spatial resolution for topography, optical spectroscopy, and he- nanoscopy. Here, I report on sensitivity and resolution achievable with HENs as well as its use for the characterization of innovative semiconductors for applications in electronics: 2D MoS2 single crystal and a p-type SnO layer. Results are supported by complementary scanning Kelvin probe microscopy, conductive AFM, and Raman measurements. HENs reveals new features of local complexity in MoS2 and poly-crystalline structure of SnO at nanometric scale otherwise undetected.

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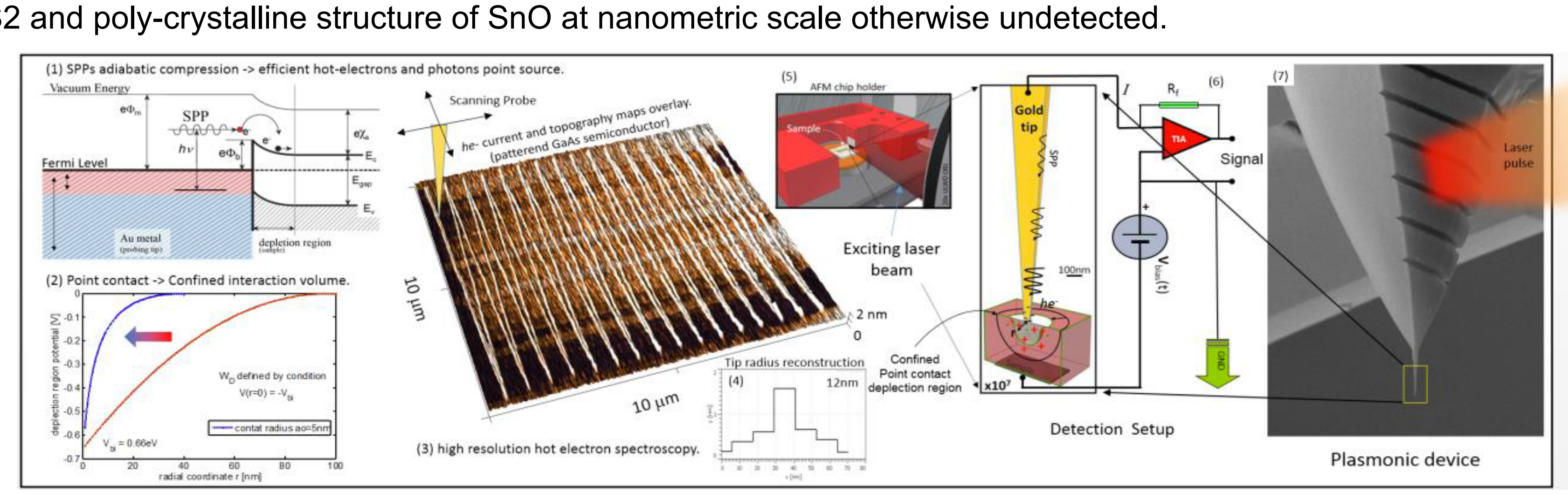

Students are cordially invited – Contact silvia.leoni@mi.infn.it