Invited Talk

O 35.1 Tue 14:00 HE 101 Magnetic phenomena, spin orbit effects, and electron transport in nanowire contacts, particularly in Platinum – *Erio Tosatti*¹, Alexander Smogunov², Andreas Dal Corso¹, Anna Dellani³, and Rüdiger Wehr⁴ – IBSSA and Democritos, Trieste, Italy —¹ICTP, Trieste, Italy —²KTH Stockholm, Sweden —³CNEA San Martín, Argentina


O 35.2 Tue 14:30 HE 101 One-dimensional low energy plasmons in Au atom chains

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One-dimensional structures are currently in the focus of theoretical and experimental research due to their unique electronic properties which cannot be found in higher dimensional materials. Recently, the plasmonic properties of one-dimensional structures have been studied in detail. [1,2,3] The dispersion of plasmons in one-dimensional nanostructures has been investigated theoretically and experimentally on nanowires and nanorods, [4,5,6] but only a few studies have considered plasmon dispersion in one-dimensional atomic structures.[7] Here, we report the unusual plasmonic properties of one-dimensional atomic chains of gold. By using a combination of scanning tunneling microscopy and spectroscopy, it is possible to investigate the electronic properties of individual gold atoms in vacuum. [8] The results show that the plasmon dispersion in these atomic chains can be significantly different from that in higher dimensional structures. [9,10]


O 35.3 Tue 14:45 HE 101 Atomic structure and electronic properties of rare earth silicide nanowires on Si(001)

†Martina Wanke¹, Christian Preinbenberger², Gerb Pruski³, Denis Vyalikh³, Sergei Molodtsov², Steffen Danzinger¹, Clemens Laubscher¹, Petar Stoiano³, Eric Huwald³, John Riley³, and Mario Dähne¹ —¹Institute of Solid State Physics, Technical University Berlin, D-10623 Berlin, Germany —²Institute of Solid State Physics, Technical University Dresden, D-01219 Dresden, Germany —³School of Physics, La Trobe University, Bundoora, VIC 3086, Australia

Scanning tunneling microscopy (STM) and angle-resolved photoemission (ARPES) are used to investigate the self-assembly and electronic structure of rare earth silicide nanowires on Si(001) surfaces. Two types of self-assembled nanowires can be formed depending in particular on annealing temperature and material exposure. In high resolution STM images we found closed-packed thin nanowires and free-standing, broad nanowires with similar properties on planar and vicinal Si(001) surfaces. Using ARPES at BESSY II for electronic characterization we discovered three strongly dispersing bands crossing the Fermi energy along the nanowire direction for the free-standing nanowires. A beginning weak dispersion of electronic states is also found for the thin nanowire type. In perpendicular direction both types only show a periodic intensity variation at the Fermi energy, but negligible dispersion. The Fermi surface shows one-dimensional electronic features.

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O 35.4 Tue 15:00 HE 101 ELS-LEED investigations of Dy-silicide nanostructures on Silicon — *Svend Vagt*¹, Eddy Patrick Rugeramigabo¹, Tadaki Nago², and Herbert Petzul³ —¹Institut für Festkörperfysik, Leibniz Universität Hannover, Germany —²National Institute for Materials Science, Tsukuba, Japan —³Institut für Festkörperfysik, Leibniz Universität Hannover, Germany

Dysprosium silicide nanostructures have been grown by depositing up to 1ML of Dy on Si(111) and on vicinal Si(001) substrates. Ultra-high vacuum conditions ($p < 1 \times 10^{-10}$ mbar during Dy deposition) are required to avoid Dy oxidation. The atomic and electronic properties of these structures have been investigated with ELS-LEED which allows the simultaneous study of geometric and electronic properties at the same point in k-space with both high momentum and energy resolution. Deposition of 1ML of Dy on Si(111) at RT followed by annealing at 500°C results in a flat monolayer with DySi2 stoichiometry. The diffraction pattern revealed the typical 1×1 structure. A 2D-Plasmon dispersion is found for the first time with $\omega/k \approx 17.5$ up to $q^* = 0.08$ Å⁻¹ in k-space. High quality arrays of parallel nanowires have been grown on 4°-vicinal Si(001) at 500°C for a Dy coverage around 0.4ML. A n×2 periodicity has been found, with n shifting from 10 to 7 for increasing coverage up to 0.75ML. The energy loss disperses only in the direction along the nanowires, whereas in the perpendicular direction the plasmon can not be excited. The plasmon dispersion turned out to be a quasi-1D-plasmon. It has been accurately simulated by explicitly taking into account the finite width of the DySi2 nanowire structures. Interactions between adjacent nanowires play a minor role.

15 min. break

Invited Talk

O 35.5 Tue 15:30 HE 101 Simultaneous electrical transport and scanning tunneling spectroscopy of carbon nanotubes — Brian J. LeRoy¹, Iddo Heller¹, Vijay K. Pahlwani², Jung Kong², Ceess Dekker³, and Sergei G. Lemay⁴ —¹Kavli Institute of Nanoscience, Delft University of Technology, The Netherlands

Using scanning tunneling spectroscopy, we demonstrate that current directly injected into a freely suspended individual single-wall carbon nanotube can be used to excite, detect and control a specific vibrational mode of the molecule. Electrons tunneling inelastically into the nanotube cause a non-equilibrium occupation of the radial breathing mode, leading to both stimulated emission and absorption of phonons by successive electron tunneling events. We exploit this effect to estimate a quality factor of well over 10,000 for this nanomechanical oscillator. We further employ the suspended geometry to perform scanning tunneling spectroscopy measurements on single-walled carbon nanotubes with independently addressable source and drain electrodes in the Coulomb blockade regime. This three-terminal configuration allows the coupling to the source and drain electrodes to be quantitatively measured, which we exploit to demonstrate that electrons were added to spin-degenerate states of the carbon nanotube. Unexpectedly, the Coulomb peaks also show a strong spatial dependence. By performing simultaneous scanning tunneling spectroscopy and electrical transport measurements we show that the probed states are extended between the source and drain electrodes and that the observed spatial dependence reflects a tip-induced modulation of the contact resistance.

Invited Talk

O 35.6 Tue 16:00 HE 101 Transport at Atomic Wires on Silicon Surfaces — Shuji Hasegawa — University of Tokyo, Tokyo, Japan

Owing to new techniques of microscopic four-point probes with four-tip scanning tunneling microscope (4T-STM) and monolithic four-point probes, electronic transport through single-atomic layers as well as

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atomic chains and nanowires on semiconductor crystals can be now measured directly. Interesting transport properties of such atomic-scale structures have been revealed; the instability and atomic-scale defects intrinsic to atomic wires play decisive roles in transport. I will introduce and summarize several topics in the talk such as metal-insulator transition, hoping conduction due to defects, inter-chain transport and so on. Recent advancements with metal-coated carbon-nanotube tips in 4T-STM are also introduced.

Structural influence towards transport: Pb wires on Si(557)

Marcin Czubanowski, Annemarie Schuster, Christoph Tegenkamp, and Herbert Pfnur — Institut of Solid State Physics, Surface Science Department, Hannover, Germany

The adsorption of 1.3 ML of Pb on Si(557) substrates followed by annealing at 640K leads to the formation of an anisotropic metallic structures as revealed by conductivity, STM and ARPES measurements. Those structures below 78K show metallic conductance along the Pb-chains, whereas in the direction perpendicular to the chain-structure an insulating behavior has been found. Additionally, ARPES measurements have shown that below \( T_c \), those structures undergo complete Fermi nesting in the direction normal to the structure. In our recent LEED experiments, the chain structure has been systematically investigated as a function of temperature by means of SPA-LEED analysis. The adsorption of Pb transforms (locally) the surface into a regularly stepped (223) facet below \( T_c \). This structure undergoes reversibly a comensurable-incomensurable phase transition at \( T_c = 78 \)K as judged from changes in position of step diffraction spots in the [112] direction and also the periodicity of domain wall reflexes in the [110] direction. Furthermore, the transition depends crucially on the Pb coverage. If the steps are decorated by excess Pb, e.g. 1.5ML, the transition is strongly suppressed.