RIKEN Seminar

Time & Date : Monday, January 17, 2011, PM 3:00-5:00
Place : Seminar room, 2nd floor, The Nano Sci. Joint Lab., RIKEN

PM 3:00-4:00

"Alumina Nanomesh: A Template for Highly Ordered Fe and Co Cluster Growth"

Prof. Peter Varga

Institute for Applied Physics, Vienna University of Technology, Austria

The structure of the ~5 Å thick aluminum oxide on $Ni_3Al(111)$, which has been solved recently, exhibits holes at the corner of the ($\sqrt{67}$ x $\sqrt{67}$)R12.2° unit cell, reaching down to the metal substrate [1]. These holes are large enough to trap atoms of any kind of metal. Therefore, the ultrathin oxide film, forming a nanomesh, should be a perfect template for growing highly regular arranged metal clusters. Several metals have been deposited on the aluminum oxide by thermal deposition and the clusters grown have been studied by scanning tunneling microscopy (STM). In agreement with literature, it has been observed that the unmodified oxide is not a good template for most metals, with the exception of Pd. Pd atoms nucleate at the corner holes and, hence, show a perfect hexagonal arrangement, whereas Fe and Co clusters grow on other local defects without showing the regularity of Pd clusters. By predeposition of a Pd seed layer, however, we can create a metallic nucleation site on each corner hole and Fe as well as Co clusters form a well-ordered hexagonal arrangement on the oxide "nanomesh". The morphology and the magnetic structure of the clusters will be discussed [2].

Support by the Austrian *Fonds zur Förderung der Wissenschaftlichen Forschung* (project S90).

[1] M. Schmid, G. Kresse, A. Buchsbaum, E. Napetschnig, S. Gritschneder, M. Reichling, P. Varga, Phys. Rev. Lett. 99, 196104 (2007). [2] A. Buchsbaum, M.De Santis, H.C.N. Tolentino, M. Schmid, P. Varga, *Phys. Rev. B 81 (2010) 115420*

PM 4:00-5:00

"Quantum oscillations, superconductivity, zero-bias anomalies, and Coulomb blockade in supported nanoscale lead islands"

Prof. Wolf-Dieter Schneider

Institute of Condensed Matter Physics, Ecole Polytechnique Fédérale de Lausanne (EPFL), CH-1015 Lausanne, Switzerland

Using scanning tunneling spectroscopy down to a temperature of 3 K, we studied the linewidth of unoccupied quantum-well states in ultrathin Pb islands, grown on Si(111) on two different Pb/Si interfaces. A quantitative analysis of the differential conductance spectra allowed us to determine the electron- electron (e-e), electron-phonon (e-ph), and the interface contributions to the lifetime. Layer-dependent ab initio calculations of the e-ph linewidth contribution are in excellent agreement with the data. Importantly, the sum of the calculated e-e and e-ph lifetime broadening follows the experimentally observed quadratic energy dependence [1].

The energy gap of these superconducting Pb islands, in a thickness range between 60 and 5 monolayers, was found to decrease from its bulk value as a function of inverse island thickness. Corresponding values of the critical temperature Tc, estimated using the bulk gap-to-Tc ratio, are in quantitative agreement with ex-situ magnetic susceptibility measurements, however, in strong contrast to previous scanning probe results. Layer-dependent ab initio density functional calculations for free-standing Pb films show that the e-ph coupling constant, determining Tc, decreases with diminishing film thickness [2].

By reducing the lateral dimensions of these nano-islands to a few nm^2, we show that the charge transport between metallic nanocontacts and various types of materials varies strikingly with diminishing contact area, manifesting itself by the subsequent appearance of zero-bias anomalies and Coulomb blockade phenomena in the differential conductance spectra [3].

[1] I.-P. Hong, C. Brun, F. Patthey, I. Yu. Sklyadneva, X. Zubizarreta, R. Heid, V. M. Silkin, P. M. Echenique, K. P. Bohnen, E. V. Chulkov, and W.-D. Schneider, Phys. Rev. B **80**, 081409 (R) (2009). [2] C. Brun, I.-P. Hong, F. Patthey, I. Yu. Sklyadneva, R. Heid, P. M. Echenique, K. P. Bohnen, E. V. Chulkov, and W.-D. Schneider, Phys. Rev. Lett. **102**, 207002 (2009). [3] C. Brun, I.-P. Hong, F. Patthey, and W.-D. Schneider, Phys. Rev. Lett., submitted. arXiv:1006.0333 [cond-mat.mes-hall]

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次世代ナノサイエンステクノロジー研究会　理研セミナーのお知らせ

日時：平成23年1月17日（月） 15時-17時

場所：ナノサイエンス実験棟　2階　セミナー室

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