MM 4: Nanostructured Materials I

Time: Monday 10:15–11:30 Location: H 0107

MM 4.1 Mon 10:15 H 0107

Electrochemically induced surface charge effect on the properties of nanoporous Au-Fe alloys — •Ajay Kumar Mishra[1], Chandrahas Bansal[1,2], and Horst Hahn[1] — [1]Institute for Nanotechnology, Forschungszentrum Karlsruhe, Karlsruhe 76021, Germany — [2]School of Physics, University of Hyderabad, Hyderabad 500 046, India

Nanoporous Au-Fe alloys consisting of nanoparticles of about 5 nm diameter were synthesized by inert gas phase condensation. Charge was induced electrochemically on the surface of the nanoparticles, and in-situ measurements of strain, magnetization, and conductivity were carried out during the charging and decharging process taking place in the electrochemical cell. The observed strain could be explained to arise from a Coulomb pressure produced by the surface charge on the metal. The variation of magnetization with charging was also found to be consistent with the effect of this pressure. A charge induced variation in the dc electrical conductivity of about 6 percent was observed. An explanation of the rate of change of conductivity with charge was provided in terms of the additional charge density produced by the induced charge. Similarly at the microscopic level, Mossbauer isomer shift and quadrupole splitting were measured and showed a small but reversible behaviour with charge.

MM 4.2 Mon 10:30 H 0107

Charge induced ITO transistor for printable electronics — •Subho Dasgupta, Sebastian Gottschalk, Robert Kruk, and Horst Hahn — 1Institute of Nanotechnology, Forschungszentrum Karlsruhe GmbH, P.O. Box 3640, D-76021 Karlsruhe, Germany

Although research on printable electronics has received increasing attention in the past two decades there are essential scientific and technical problems still to be addressed prior to commercialization. In general, printable electronics with organic or inorganic channels suffer from either very low mobility (pentacene or amorphous silicon FETs) or their fabrication is complicated, costly, requires sophisticated techniques, or involves high processing temperature (polycrystalline silicon or semiconducting oxide FETs). We have fabricated an alternative electrochemically gated JFET with commercial ITO nanoparticles as a channel (with nearly metallic conductance) and an electrolyte as a gate. The device principle is based on a charge induced variation of drain current without any redox reaction at the electrolyte/particle interface. Depending on the electrolyte used, the on/off ratio can be as high as 103. The calculated field-effect mobility is in the range 30-60 cm^2/Vs when the whole channel is considered as an array of nanowires whose diameter is equal to the average neck diameter of the nanoparticles. The subthreshold swing (415 mVdec-1) is lower than most of the printable FETs reported so far. The high conductance of the channel can offer added advantage with high on-state current for submicron device sizes. Similar devices fabricated with a solid polymeric electrolyte as a gate dielectric can be ultracheap and readily printable.

MM 4.3 Mon 10:45 H 0107

Energy Transfer in Solution-Based Complexes of CdTe Nanocrystals Electrostatically Bound by Calcium Ions — •Sergiy Mayilo, Jan Hilhorst, Andrei S. Susha, Cornelia Höhl, Thomas A. Klar, Andrey L. Rogach, and Jochen Feldmann — Photonics and Optoelectronics Group, Department of Physics and CeNS, Ludwig-Maximilians Universität München, Germany

Colloidal semiconductor nanocrystals with controllable surface properties are attractive objects for use as building blocks in different functional structures within the bottom-up assembly approach. We produced stable complexes from differently-sized water soluble CdTe nanocrystals capped by mercaptoacid stabilizers through electrostatic interactions of negatively charged carboxylic groups of capping ligands with positively charged Ca(II) cations. Energy transfer between smaller nanocrystals (donors) and larger nanocrystals (acceptors) in fabricated complexes is demonstrated by means of steady-state and time-resolved photoluminescence spectroscopy, paving the way to nanocrystal-based light harvesting structures.

MM 4.4 Mon 11:00 H 0107

Electronic transport properties of individual chemically reduced graphene oxide sheets — •cristina gómez-navarro[1], thomas weitz[1], alexander bittner[1], mateo scolari[2], alf mews[2], marko burghard[1], and klaus kern[1] — [1]Max-Planck-Institut fuer Festkoerperforschung, Heisenbergstrasse 1, 70569 Stuttgart, Germany — [2]Department of Chemistry, University of Siegen, D-57068 Siegen, Germany

The peculiar electronic properties of graphene sheets have attracted substantial interest in the scientific community during the past few years (1-2). Micromechanical cleavage is currently the most effective method to produce high-quality graphene sheets. However this method does not enable the large-scale production required for most applications. Consequently alternative production methods for graphene sheets are highly desirable. Here we report on the electronic transport properties of single graphene sheets obtained via chemical reduction of graphite oxide. We find that reduced single layers exhibit room temperature conductivities of 0,05-2 S/cm and field effect mobilities of 2-200cm2/Vs. Temperature dependent electrical measurements and Raman spectroscopic investigations reveal that charge transport occurs via variable range hopping between intact graphene islands with sizes of the order of several nanometers. The electrical properties of sheets composed of two and more layers will be also discussed (3).

1. K. S. Novoselov et al., Science 306, 666 (2004).
2. C. Berger et al., Science 312, 1191 (2006).
3. C.Gómez-Navarro et al. Nanoletters (2007)

MM 4.5 Mon 11:15 H 0107

Observation of coherent electron motion in disordered granular metals — •Michael Huth, Dirk Klingenberger, and Christina Grimm — Physikalisches Institut, Goethe-Universität, D-60438 Frankfurt am Main, Germany

We observed a $\sigma \propto \sqrt{T}$-dependence of the electrical conductivity σ vs. temperature T in metal-insulator nanocomposite samples prepared by electron beam induced deposition. This dependence was recently predicted as a low-energy contribution in the metallic regime of 3D granular metals if electron-electron interactions are taken into account[1]. It is the consequence of the occurence of a large-scale coherent electron motion and signifies a universal resistive behavior in granular metals even in the presence of disorder.

[1]I. S. Beloborodov, K. B. Efetov, A. V. Lopatin, and V. M. Vinokur, Phys. Rev. Lett. **91**, 246801 (2003); I. S. Beloborodov, A. V. Lopatin, V. M. Vinokur, and K. B. Efetov, Rev. Mod. Phys. **79**, 469 (2007)