MM 28: Electronic Properties I

Time: Wednesday 10:15–11:45 Location: IFW D

MM 28.1 Wed 10:15 IFW D

The Tuneable Electron Mobility in Charged Indium Tin Oxide Thin Films — •Subho Dasgupta, Maya Lukas, Robert Kruk, and Horst Hahn — Institute for Nanotechnology, Forschungszentrum Karlsruhe GmbH, P.O. Box 3640, D-76021 Karlsruhe, Germany

This study aims at the quantitative understanding of the change in electronic transport upon surface charging in nanoparticulate and nanocrystalline conducting oxide. Previously, we demonstrated a device with a metallic conducting channel made of Indium Tin Oxide (ITO) nanoparticles which exhibits an on/off ratio of 2×10^3 [1]. To find the mechanism of such a large change in conductivity, we prepared nanocrystalline ITO thin films of a few nanometers thickness as a model system. It was observed that an increase in the Sn-doping level near the grain boundaries results in a local variation in the screening length upon charging. This variation is considered to be equivalent to an increase in the surface roughness resulting in the disruption of the conducting paths. It is concluded that primarily a change in the scattering probability is causing the high value of variation in transport properties for highly-doped semiconductors like ITO.

[1] S. Dasgupta, S. Gottschalk, R. Kruk, H. Hahn, Nanotechnology 19 (2008) 435203

MM 28.2 Wed 10:30 IFW D

The electrical properties of anodically oxidized Ti based NWFETS and its oxygen sensor applications — •Dawit Gedamu, Seid Jebril, Arnim Schuchardt, and Rainer Adelung — Functional Nanomaterials, Institute of Materials Science, Faculty of Engineering, CAU Kiel

A number of techniques have been reported on fabrication of tunnel junction nano structures through anodization in the last decade , . The dimension of such structures can be miniaturized and controlled through the anodic voltage while anodizing. A TiO2 tunnel junction of controlled thickness is similarly produced through anodic oxidation of Ti nanowires produced in a fracture approach . By using an electrochemically grown TiO2 as a gate oxide, we demonstrate nanowire field effect transistors (NWFET) which can be further used as oxygen sensor. Although FET based sensors are undoubtedly of great importance for microelectronics smart sensors, there are limited sensor reports on FET sensor. Gas detection based on this technique relies largely on change of the metal work function in the Schottky diode or MOSFETs induced by catalytic reaction on the solid surface . Here, the oxygen sensing properties are also demonstrated.

MM 28.3 Wed 10:45 IFW D

Phonon absorption at low temperature - determination of the indirect band gap in FeSi using Fourier-spectroscopic infrared ellipsometry — •Dirk Menzel[1], Paul Popovich[2], Alexander V. Boris[2], and Joachim Schoenes[1] — [1]Institut für Physik der Kondensierten Materie, TU Braunschweig, Germany — [2]Max-Planck-Institut für Festkörperforschung, Stuttgart, Germany

The determination of the band gap is an important parameter for the characteristics of a semiconductor. However, for FeSi the size of the gap is not reported consistently so far. Using far-infrared spectroscopic ellipsometry we have reliably determined the dielectric function of FeSi. As predicted by band structure calculations both a direct and an indirect band gap are observed from the absorptive part of the dielectric function which amount to 73 meV and 10 meV, respectively. The absolute value of the indirect gap can only be evaluated when both phonon absorption and emission are observed. At low temperature, however, the former does not occur which generally makes it impossible to obtain the indirect gap energy in the low temperature range. For the ellipsometric measurements we used a Fourier transform spectrometer and, therefore, illuminated the sample with white light. This leads to a continuous generation of optical phonons which may also decay into low-energy acoustic phonons. This method enables one to derive the absolute value of the indirect gap even the low temperature.

MM 28.4 Wed 11:00 IFW D

$Co_xFe_{(x-1)}S_2$: How close to half-metallicity? — •C. Utfeld[1], S. R. Giblin[2], J. W. Taylor[2], J. Laverock[1], S. B. Dugdale[1], C. Shenton-Taylor[3], J. A. Duffy[3], L. Wang[4], C. Leighton[4], M. Itou[5], and Y. Sakurai[5] — [1]H.H. Wills Physics Laboratory, University of Bristol, Tyndall Avenue, Bristol BS8 1TL, UK — [2]ISIS Facility, RAL, Chilton, Oxfordshire OX11 0QX, UK — [3]Department of Physics, University of Warwick, Coventry CV4 7AL, UK — [4]Chem. Eng. & Mat. Sci., University of Minnesota, Minneapolis, MN 55455, USA — [5]SPring-8, 1-1-1 Kouto, Mikazuki, Sayo, Hyogo 679-5198, Japan

CoS_2 is a material thought to be very close to being a half-metal, i.e. to only be conducting in one spin. However, the Fermi level lies low in the conduction bands and doping with the isostructural semiconductor FeS_2 is predicted to gradually unoccupy one spin channel. In this context the evolution of the polarisation across the series $Co_xFe_{(1-x)}S_2$ is of major interest. Experimentally the number of direct measurements accessing the bulk polarisation for different alloy compositions is rather limited. We present a magnetic Compton scattering study combined with *ab initio* calculations as a method to determine the bulk spin polarisation in CoS_2 and $Co_{0.9}Fe_{0.1}S_2$. Magnetic Compton scattering is a versatile technique for investigations into spin-dependent bulk properties because it probes the unpaired electrons directly. We compare the data with theoretical predictions and optimise the agreement by rigidly shifting the bands in order to extract the *tuned* bulk polarisations of P≈-75% and P≈18% for the pure and the x=0.1 system, respectively.

MM 28.5 Wed 11:15 IFW D

Photoemission insight into heavy-fermion behavior at the nanoscale — •Denis Vyalikh[1], Steffen Danzenbächer[1], Yuri Kucherenko[2], Cornelius Krellner[3], Christoph Geibel[3], Serguei Molodtsov[1], and Clemens Laubschat[1] — [1]Institut für Festkörperphysik, Technische Universität Dresden, D-01062 Dresden, Germany — [2]Institute of Metal Physics, National Academy of Sciences of Ukraine, UA-03142 Kiev, Ukraine — [3]Max-Planck-Institut für Chemische Physik Fester Stoffe, Nothnitzer Strasse 40, D-01187 Dresden, Germany

We unraveled the hybridization phenomenon between f- and d- states at the Fermi level in the $YbRh_2Si_2$ (YRS) heavy-fermion material. The intriguing point is that upon electron doping the hybridization strength can be systematically tuned. It is demonstrated that gradual deposition of silver atoms onto atomically clean YRS-surface leads to charge transfer from the Ag $5s$ into the Rh $4d$ bands substantially changing the energetical overlap of these states and, consequently, the hybridization strength. Another fascinating point is that silver atoms do not penetrate deep inside the crystal, consecutive forming well ordered monolayer's structure. It is an evidence that observed tunable hybridization appears only in the surface region. Then it should reveal its own properties, like heavy-fermion behavior, which can be rather different from the bulk.

MM 28.6 Wed 11:30 IFW D

Relative Sub-shell Photoionization Cross-sections of Selected Metals Determined by Hard X-ray High Kinetic Energy Photoemission — •Mihaela Gorgoi, Franz Schäfers, Walter Braun, and Wolfgang Eberhardt — BESSY II Elektronenspeicherring, Helmholtz-Zentrum Berlin für Materialien und Energie, Berlin, Deutschland

Recently, hard x-ray high kinetic energy photoelectron spectroscopy has lead to a break-through due to its non destructive way of investigating the bulk electronic properties of materials. However, due to the relatively new development of this technique there is a lack of information concerning the photoionization cross section at high energies. Whenever compound materials are investigated or when estimating signal levels and the feasibility of an electron spectroscopy experiment the knowledge of cross sections is essential. Thus in the present work we will show the experimentally determined relative sub-shell photoionization cross sections of selected metals in the energy range of 2 to 10 keV. Based on previous experimental studies of Kunz et al. [1] Au 4f cross sections were used as reference. The data will be compared with the calculated sub-shell photoionization cross sections and the differences will be discussed. [1] C. Kunz, S. Thiess, B.C.C. Cowie, T.-L. Lee, J. Zegenhagen, Nuclear lnstruments and Methods in Physics Research A 547, 73-86 (2005).