HL 22: Hybrid systems

Time: Tuesday 9:30–11:00 Location: EW 201

HL 22.1 Tue 9:30 EW 201

Coherent exciton - surface plasmon polariton interaction in hybrid metal semiconductor nanostructures — •Parinda Vasa[1,2], Robert Pomraenke[1], Stephan Schwieger[2], Yuri Mazur[3], Vasyl Kunets[3], Erich Runge[2], Gregory Salamo[3], and Christoph Lienau[1] — [1]Insitut für Physik, Carl von Ossietzky Universität Oldenburg, 26129 Oldenburg, Germany — [2]Technische Universität Ilmenau, Theoretische Physik I, Postfach 100565, 98684 Ilmenau, Germany — [3]Department of Physics, University of Arkansas, Fayetteville, Arkansas 72701, USA.

We report the first measurement of a coherent coupling between Surface Plasmon Polaritons (SPPs) excited on a metal grating and excitons in a GaAs/AlGaAs Quantum Well (QW). The hybrid metal-semiconductor nanostructure is fabricated by molecular beam epitaxy followed by electron beam lithography. The structure is designed to maximize the radiative interaction between the two excitations which is probed by low-temperature, angle-resolved, far-field reflectivity measurements. As a result of the coupling, a significant shift of $\sim$ 7meV and an increase in broadening by $\sim$ 4meV of the QW exciton resonance are observed. The coupling strengths are calculated based on a phenomenological, coupled oscillator model and are found to be as large as 50meV. Such a strong interaction can significantly enhance the luminescence yield of a semiconductor.

HL 22.2 Tue 9:45 EW 201

Electromagnetic Interaction between a Quantum Dot and Metallic Structures in the Optical Sub-wavelength Regime — •Matthias Reichelt[1,2], Colm Dineen[2], Armis R. Zakharian[2], Jerome V. Moloney[2], and Stephan W. Koch[3] — [1]Department Physik, Fakultät für Naturwissenschaften,Universität Paderborn, Warburger Str. 100, D-33098 Paderborn, Germany — [2]Department of Mathematics, University of Arizona, Tucson AZ 85721, USA — [3]Department of Physics and Material Sciences Center, Philipps University, Renthof 5, D-35032 Marburg, Germany

Recently the investigation of sub-wavelength metallic structures has been of great interest since surface plasmonic effects generate large confined electric fields [1]. In this work we study a combined system of a quadrupole-like bowtie and a quantum dot and present a numerical approach for calculating the electromagnetic field and the microscopic material equations simultaneously [2]. As application we compute the electromagnetic force [3] on the quantum dot under different excitation conditions. We show that it is possible to confine the dot laterally in the bowtie gap region (<100nm).

[1] P.J. Schuck *et al.*, Phys. Rev. Lett. **94**, 017402 (2005)
[2] M. Reichelt, C. Dineen, S.W. Koch, and J.V. Moloney, submitted
[3] P. Meystre, *Atom Optics*, Springer (2001)

HL 22.3 Tue 10:00 EW 201

Photoresponse of Hybrids made of Carbon Nanotubes and CdTe Nanocrystals — •Bernd Zebli[1], Hugo A. Vieyra[1], Itai Carmeli[2], Achim Hartschuh[3], Jörg P. Kotthaus[1], and Alexander W. Holleitner[4] — [1]Department für Physik and Center for NanoScience (CeNS), Ludwig-Maximilians-Universität München, Geschwister-Scholl-Platz 1, 80539 Munich, Germany — [2]Department of Chemistry and Biochemistry, Tel-Aviv University, Tel-Aviv 69978, Israel — [3]Department für Chemie, Physikalische Chemie, Butenandtstr. 5-13 E, 81377 Munich, Germany — [4]Walter-Schottky Institut, Technische Universität München, Am Coulombwall 3, 85748 Garching, Germany

We observe that the photoresponse of single-walled carbon nanotubes can be adjusted by the absorption characteristics of colloidal CdTe nanocrystals, which are bound to the side-walls of the carbon nanotubes via molecular recognition. To this end, the hybrid systems are characterized using charge transport measurements under resonant optical excitation of the carbon nanotubes and nanocrystals, respectively. We investigate the photoresponse of both ensembles of hybrid systems and single carbon-nanotube-nanocrystal-hybrids. The data suggest a bolometrically induced increase of the current in the carbon nanotubes, which is due to photon absorption in the nanocrystals.

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HL 22.4 Tue 10:15 EW 201

Comparison of Charge Transport in organic P3HT and inorganic Al-doped zinc oxide nanoparticles — •Maria Hammer[1], Daniel Rauh[2], Ingo Riedel[2], Carsten Deibel[1], and Vladimir Dyakonov[1,2] — [1]Experimental Physics VI, Physical Institute, Julius-Maximilians-University of Würzburg, Am Hubland, D-97074 Würzburg — [2]ZAE Bayern, Div. Functional Materials for Energy Technology, Am Hubland, D-97074 Würzburg, Germany

The preparation of electronic devices from solution receives a lot of attention nowadays due to the low cost potential. One approach is an organic–inorganic hybrid system for applications in solar cells. For a deeper understanding of these material combinations, we examine the charge transport in the organic semiconductor poly(3-hexylthiophene) and the inorganic Al-doped zinc oxide nanoparticles, respectively. We present the charge carrier mobility in dependence of the charge carrier densities and temperature measured on field effect devices. Contact effects due to the workfunction of the injecting electrodes are taken into account. We survey the properties of the transport in these disordered systems, organic and inorganic, in the high carrier concentration regime. Those will be discussed with respect to the underlying transport models.

HL 22.5 Tue 10:30 EW 201

Light-Induced Charge Transfer in Hybrid Composites of Silicon Nanocrystals and Organic Semiconductors — •Roland Dietmüller[1], Sabrina Niesar[1], Robert Lechner[1], André R. Stegner[1], Rui N. Pereira[1], Martin S. Brandt[1], Martin Trocha[2], Hartmut Wiggers[3], and Martin Stutzmann[1] — [1]Walter Schottky Institut, Technische Universität München, Am Coulombwall 3, 85748 Garching, Germany — [2]Evonik Degussa GmbH, Paul-Baumann-Str.1, 45772 Marl, Germany — [3]Institut für Verbrennung und Gasdynamik, Universität Duisburg-Essen, Lotharstr. 1, 47048 Duisburg, Germany

Organic semiconductors have received a lot of attention for novel, low cost electronic applications. Silicon or SiGe nanocrystals could be incorporated in such organic devices to tailor their physical properties. For example, hybrid organic/inorganic solar cells could benefit from the solution processing of the organic and inorganic components and from the broad absorption range of the non-toxic silicon.

We have investigated the charge transfer between Silicon nanocrystals (Si-nc) and organic semiconductors via light-induced electron spin resonance (LESR). Composites of Si-nc with the π-conjugated polymer poly(3-hexylthiophene-2,5-diyl) (P3HT) and with the fullerene derivate [6,6]-phenyl C-61-butyric acid methyl ester (PCBM) have been probed with LESR. The LESR measurements show that a light-induced charge transfer between Si-nc and P3HT takes place, which results in a positive polaron on the P3HT. PCBM, in contrast, acts in composites with Si-nc as an electron acceptor and after illumination a long-living radical anion of PCBM can be detected.

HL 22.6 Tue 10:45 EW 201

Real space imaging of the Fe/GaAs(110) interface with Cross-Sectional Scanning Tunneling Microscopy — •Lars Winking, Martin Wenderoth, Jan Homoth, Swante Sievers, and Rainer G. Ulbrich — IV. Phys. Inst., Georg-August-Universität Göttingen

The unique nearly lattice-matched system Fe on GaAs is a promising candidate for future spintronics applications. Spin-injection has already been demonstrated by several groups even though the obtained efficiencies are still limited [1,2]. It is assumed that this shortcoming is due to imperfections at the Fe/GaAs heterointerface, however up to now is not clear weather defects at the interface that lead to very leaky Schottky diodes [2], or the formation of a nonmagnetic interface compound are responsible [1]. In this contribution we present the first real space investigation of the Fe/GaAs(110) interface with Scanning Tunneling Microscopy across the cleaved interface. This new approach enables us to explore the structural as well as the electronic properties of the Fe/GaAs(110) interface with atomic resolution [3]. We can directly link the atomic structure of the heterointerface to spatially varying electronic properties like the local potential Φ in the GaAs space charge layer and the variation of the Schottky barrier height along the interface. This work was supported by the DFG-SFB 602 TP A7

[1] K. H. Ploog, JAP, 91, pp. 7256 (2002) [2] A. Hirohata et al., PRB

66, 035330 (2002) [3] T.C.G. Reusch et al., PRL 93, 206801(2004)