CPP 34 Novel materials II

Zeit: Mittwoch 11:15–12:30 Raum: TU C230

CPP 34.1 Mi 11:15 TU C230

Exciton recycling in graded gap nanocrystal structures — •Thomas Franzl, Thomas A. Klar, Stefan Schietinger, Andrey L. Rogach, and Jochen Feldmann — Photonics and Optoelectronics Group, Physics Department and CeNS, Ludwig-Maximilians-Universität München

We present a cascaded energy transfer (CET) structure made of CdTe nanocrystals motivated by natural antenna complexes and by semiconductor heterostructure lasers. Funnel like band gap profiles are realized by applying layer-by-layer assembly to CdTe nanocrystals of distinct sizes. For high-energetic excitation, the CET structure comprising only one layer of red-emitting nanocrystals emits 4 times more red light than a reference sample of equal absorbance consisting of only red emitting nanocrystals. Hence the final excitation density in the single emitting layer of large nanocrystals is increased by a factor of 28. Time resolved measurements show that the photoluminescence from the central layer is fed from long lived states. The super-efficient exciton funneling can be explained by a fast direct energy transfer along the structure and a recycling of surface trapped excitons that are usually lost for photoluminescence [1].

[1] T. Franzl, T.A.Klar, S. Schietinger, A.L. Rogach, J. Feldmann, "Exciton recycling in graded gap nanocrystal structures"Nano Letters, 4, 1599 (2004)

CPP 34.2 Mi 11:30 TU C230

Prepatterning of substrates via diblock copolymer lithography — •Danilo Zschech[1], Dong Ha Kim[2], Alexey P. Milenin[1], Martin Steinhart[1], and Ulrich Gösele[1] — [1]Max Planck Institute of Microstructure Physics, Weinberg 2, 06120 Halle, Germany — [2]Max Planck Institute of Polymer Research, Ackermannweg 10, 55128 Mainz, Germany

A simple and versatile access to ordered porous materials having lattice constants of a few tens of nanometers and below is based on the use of self-assembled diblock copolymer films as lithographic masks. Thin films of PS-b-PMMA on various substrates consisting of cylindrical domains of the minor phase PMMA normal to the film plane were prepared by spincasting and annealing under inert atmosphere. After development and removal of the minor phase we enhanced the etch contrast of the major phase consisting of PS by staining with ruthenium tetroxide. We employed reactive ion etching (RIE) to transfer the pattern into the underlying substrates and obtained, for instance, ordered mesoporous silicon. The thus patterned structures may be used as high temperature-resistant lithographic masks for the growth of ordered nanowire arrays.

CPP 34.3 Mi 11:45 TU C230

Electronic structure of heteronuclear metal-organic supramolecules — •Rainer Fink[1], Norman Schmitt[1], Rolf Saalfrank[2], and David Batchelor[3] — [1]Univ. Erlangen, Physikalische Chemie II, Egerlandstr. 3, 91058 Erlangen — [2]Univ. Erlangen, Inst.f.organische Chemie, Henkestr. 42, 91054 Erlangen — [3]Univ. Würzburg, Experimentelle Physik II, Am Hubland, 97074 Würzburg

Supramolecular aggregates containing ferromagnetic atoms are attracting increased interest due to potential applications in quantum computing and spintronics (spin tunneling). We have prepared thin films of various types of molecules containing a distinct number of Fe and Mn atoms. The 6-fold heteronuclear substances are also known as "ferric wheels". In these molecules the metal atoms couple antiferromagnetically but may nevertheless lead to a resulting magnetic moment with interesting magnetic properties [1]. Depending on the preparation from the solvent, we observe different film morphologies, which also exhibit different electronic properties as monitored by near-edge x-ray absorption fine structure (NEXAFS). In particular the absorption data of the metal edges allow detailed insight into the valency of the metal atoms, and the influence of the organic ligand shell. Spatially resolved spectromicroscopy data of these materials allow structure-property relationships which may be due to the different chemical reactivity of nanocrystalline films. This work is funded by the DFG within SFB 583 (TP C9).

[1] O. Waldmann et al., Phys. Rev. Lett. 89 (2002) 246401

CPP 34.4 Mi 12:00 TU C230

Elemental trace analysis in presolar meteorite dust using the nano-ESCA — •P. Bernhard[1], Ch. Ziethen[1], H.J. Elmers[1], J. Maul[1], G. Schönhense[1], M. Escher[2], N. Weber[2], M. Merkel[2], B. Krömker[3], D. Funnemann[3], S. Schmidt[4], F. Reinert[4], F. Forster[4], and S. Hüfner[4] — [1]Johannes Gutenberg Universität, Institut für Physik, Staudinger Weg 7, 55128 Mainz — [2]FOCUS GmbH, Am Birkhecker Berg 20, 65510 Hünstetten — [3]OMICRON nanotechnology GmbH, 65232 Taunusstein — [4]Universität des Saarlandes, FR 7.2 Experimentalphysik, 66041 Saarbrücken

Trace elements with very small concentrations have been detected in presolar meteorite dust via their local XPS spectra using the nano-ESCA instrument [1]. Small area spectra as well as energy filtered images in the binding-energy range between 0 and 750 eV have been acquired for a sample from the Murchison meteorite that consists essentially of presolar silicon carbide grains. These grains incorporate a number of minor and trace elements [2]. Our high energy (110 meV) and spatial resolution (100 nm range) allow a detailed analysis of the prominent lines of the main constituents (Si 2p and 2s, C 1s) as well as the 3d lines of transition metals and the 4d lines of several rare earth elements contained in the sample. Significant core level shifts give access to the chemical state of the trace elements. [1] M. Escher et al., J. Phys.: Cond. Matt. (2004) in print [2] P. Hoppe and U. Ott, in Astrophysical Implications of the Laboratory Study of Presolar Materials, CP402, American Institute of Physics (1997) 27 Thanks are due to U. Ott and J. Maul for the loan of the sample, financial support by BMBF (13N 7863) is gratefully acknowledged.

CPP 34.5 Mi 12:15 TU C230

Spin-conserving carrier recombination in conjugated polymers — •M. J. Walter[1], M. Reufer[1], P. G. Lagoudakis[1], U. Scherf[2], J. M. Lupton[1], and J. Feldmann[1] — [1]Photonics and Optoelectronics Group, Physics Department and CeNS, Ludwig-Maximilians-Universität, Munich, Germany — [2]FB Chemie, Universität Wuppertal, Gauss-Str. 20, Wuppertal, Germany

The question about the maximum internal quantum efficiency η achievable in polymeric LEDs is strongly debated but still unresolved. As generally only singlets contribute to the electroluminescence, η should be limited to 25 % according to simple spin statistics. While several publications suggest that this upper bound could be surpassed, little is known about the crucial exchange energy of exciton precursor polaron pairs (PPs) that plays a major role in the respective argumentation of increasing η.

By applying an external electric field we can store PPs over relatively long time scales and spectroscopically probe their spin-state by the use of a novel class of phosphorescent polymeric material [1]. During the electrostatic PP storage effective mixing of singlet- and triplet-PPs cannot be observed even at room temperature, suggesting an astonishingly strong exchange interaction within the PP. In the absence of fast spin-lattice-relaxation within the coulombically bound state, $\eta > 25$ % appears unlikely.

[1] J. M. Lupton *et al.*, *Phys. Rev. Lett.* **89**, 167401 (2002).