HL 80: II-VI-compounds other than ZnO

Time: Thursday 11:45–13:00 Location: H15

HL 80.1 Thu 11:45 H15

Point native defects and p-type conductivity of ZnRh2O4: a first principles study — Oksana Volnianska[1] and •Piotr Boguslawski[1,2] — [1]Institute of Physics PAS, al. Lotnikow 32/46, 02-668 Warsaw, Poland — [2]Institute of Physics, Kazimierz Wielki University, 85-064 Bydgoszcz, Poland

Transparent conducting oxides are the subject of active current research in the context of applications in semiconductor devices and photovoltaics. ZnRh2O4, with the band gap of about 2.2 eV, is a member of this class. It crystallizes in the spinel structure, and exhibits a p-type conductivity. Using the density functional theory within the generalized gradient approximation we calculated the electronic structure and formation energies of point native defects in ZnRh2O4 (vacancies, interstitials, and antisites). In the oxygen-rich conditions, there are two defects with formation energies lower than 1 eV, and therefore expected to occur at high concentrations, namely the zinc vacancy and the zinc antisite. Both defects are shallow acceptors that can be responsible for the observed p-type conductivity of ZnRh2O4. Formation energies of the remaining defects exceed 3 eV, and thus they are not expected to affect properties of ZnRh2O4.

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HL 80.2 Thu 12:00 H15

Importance of oxygen vacancies for the two dimensional metallic state at the surface of $SrTiO_3$ — •Juan Shen, Harald O Jeschke, and Roser Valenti — Institut für Theoretische Physik, Goethe-Universität Frankfurt, Max-von-Laue-Straße 1, 60438 Frankfurt am Main

We analyze by means of density functional theory (DFT) the electronic structure of various oxygen-deficient ($SrTiO_3$) surface slabs. We find a significant surface reconstruction after introducing oxygen vacancies and we show that the charges resulting from surface-localized oxygen vacancies -independently of the oxygen concentration- redistribute in the surface region and deplete rapidly within a few layers from the surface suggesting the formation of a two-dimensional electron system (2DES). We also investigate possible oxygen-vacancy clustering effects and discuss our results in the context of recent angle-resolved photoemission spectroscopy observations of a highly metallic 2DES at the (001) vacuum-cleaved surface of $SrTiO_3$.

HL 80.3 Thu 12:15 H15

Towards ion beam synthesis of single CdSe nanocrystal quantum dots in a SiO_2 matrix — •Hans Moritz Mangold[1], Jörg B. Kinzel[1], Helmut Karl[2], Hubert J. Krenner[1], and Achim Wixforth[3] — [1]Emmy Noether Group at Lehrstuhl Experimentalphysik 1, Universität Augsburg, Deutschland — [2]Lehrstuhl Experimentalphysik IV, Universität Augsburg, Deutschland — [3]Lehrstuhl Experimentalphysik I, Universität Augsburg, Deutschland

II-VI compound semiconductor quantum dots (QDs) are a promising class of materials for applications in optical devices in the visible spectral domain. Here we show that in addition to traditional fabrication techniques such as molecular beam epitaxy or chemical synthesis, high fluence ion-beam implantation followed by a rapid thermal annealing step, can be readily applied to synthesize CdSe nanocrystals with superior optical properties within the thermal oxide on a Si wafer. In order to confine the implantation volume we employ chromium masks with arrays of nanoscale aperture openings with diameters smaller than 250nm. We analyzed the such implanted and annealed samples by scanning electron microscopy and micro-photoluminescence spectroscopy. We observe a pronounced broadening and blue shift of the nanocrystal emission when decreasing the aperture diameter to $< 1000\,\mathrm{nm}$. We attribute this behavior to a reduction of the mean nanocrystal size but increase of its size distribution. For the smallest aperture sizes used we observe a pronounced shell-filling behavior characteristic for single quantum dot nanoemitters.

HL 80.4 Thu 12:30 H15

Blue lasing and strong coupling in ZnSe monolithic microcavities — •Kathrin Sebald, Moritz Seyfried, Sebastian Klembt, Carsten Kruse, Detlef Hommel, and Jürgen Gutowski — Institute of Solid State Physics, University of Bremen, Germany

Microcavity structures which consist of a cavity located between two distributed Bragg reflectors can be used to study light-matter interaction in the weak and strong coupling regime. In this contribution microcavities with one or three ZnSe quantum wells embedded into the cavity are presented. By increasing the number of implemented ZnSe quantum wells strong coupling was demonstrated to be achieved with a Rabi splitting energy in the order of 19 meV. By excitation density dependent measurements the transition from the strong to the weak coupling regime was observed. In addition, sample areas with a smaller quality factor show already at low excitation densities just the bare cavity emission. This cavity emission reveals a minimal lasing threshold of 5 pJ for the cavity photons. From the integrated intensity of the sample in the strong and weak coupling regime the β factor can be estimated which describes the fraction of spontaneous emission coupled into the cavity mode. As expected, the sample area with the pure cavity emission possesses a small β factor of 0.01 comparable to classical VCSEL structures. In contrast to that the β factor reaches a value of 0.18 in the sample area where the strong coupling regime was observed.

HL 80.5 Thu 12:45 H15

Control of the spontaneous emission of CdTe QDs by means of micropillar cavities — •Tomasz Jakubczyk[1,2], Wojciech Pacuski[1,2], Tomasz Smoleński[1], Matthias Florian[3], Frank Jahnke[3], Carsten Kruse[2], Piotr Kossacki[1], and Detlef Hommel[2] — [1]Institute of Experimental Physics, Faculty of Physics, University of Warsaw, Poland — [2]Institute of Theoretical Physics, University of Bremen, Germany — [3]Institute of Solid State Physics, University of Bremen, Germany

Pillar microcavities containing quantum dots (QDs) represent an excellent tool for exploring and enhancing effects due to the light-matter interaction in semiconductor structures. We present results prooving a significant improvement of the control over the spontaneous emission of CdTe/ZnTe QDs by means of an all-epitaxial ZnTe-based pillar cavity.

We investigated QD's excitonic emission near resonance with the fundamental micropillar cavity mode. Temperature variation of the detuning between the exciton energy and the cavity mode was performed and a significant shortening of the decay time for the QD state was found at zero-detuning. A Purcell factor over 5 was determined and confirmed by the extended transfer matrix method calculations.