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S E M I N A R
aus
Halbleiterphysik und Nanotechnologie

Di, 8.5.2018, 13:00 Uhr, Hörsaal für Physik

"Enhanced Vibrational Spectroscopy of Semiconductor Nanocrystals"

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Semiconductor nanocrystals (NCs) or quantum dots (QDs), e.g. colloidal CdSe NCs, are found in numerous applications, in particular as strong luminescent light emitters as their size dependent light emission can cover the entire visible spectral range. While the luminescence can be detected easily even for single QDs, recording the Raman spectrum of a single QD and thus determining its vibrational properties remains a challenge.

Here we use the example of CdSe quantum dots to illustrate several approaches how the Raman response of the QDs can be enhanced and finally quasi-single QD Raman spectra can be obtained. Beginning with enhancement via resonant excitation and utilizing interference enhanced Raman scattering this contribution will then focus on an investigation of resonant surface-enhanced Raman scattering (SERS) by optical phonons in colloidal CdSe NCs homogeneously deposited on arrays of Au nanoclusters using the Langmuir–Blodgett technique. Special attention is paid to the determination of the localized surface plasmon resonance (LSPR) energy in the arrays of Au nanoclusters as a function of the nanocluster size by means of micro-ellipsometry. SERS by optical phonons in CdSe NCs shows a significant enhancement factor with a maximal value of 2×10^3 which depends resonantly on the Au nanocluster size and thus on the LSPR energy. The deposition of CdSe NCs on the arrays of Au nanocluster dimers enabled us to study the polarization dependence of SERS. It was found that a maximal SERS signal is observed for the light polarization along the dimer axis. Finally, SERS by optical phonons was observed for CdSe NCs deposited on structures with a single Au dimer. A difference of the LO phonon energy is observed for CdSe NCs on different single dimers. This effect is explained as the confinement-induced shift which depends on the CdSe nanocrystal size and indicates quasi-single NC Raman spectra being obtained. Finally the application of tip-enhanced Raman scattering (TERS) to single QDs will be discussed.