Tunneling spectroscopy of semiconductor nanocrystals in superlattices

PHYS 521

Bruno Grandidier, bruno.grandidier@isen.fr[1], Karin Overgaag, K.Overgaag@phys.uu.nl[2], C. Delerue[3], and Daniel Vanmaekelbergh, D.A.M.Vanmaekelbergh@phys.uu.nl[2]. (1) ISEN Physics, IEMN-CNRS, 41 bd Vauban, Lille, 59000, France, (2) Debye Institute, Utrecht University, Utrecht, 3508, Netherlands, (3) Institute for Electronics, Microelectronics and Nanotechnologies (IEMN), CNRS, BP69, Avenue Poincare, F-59652cedex, Villeneuve d'Ascq, France

Colloidal semiconductor nanocrystals (NCs) are quantum-size-effect tunable and processible from organic or aqueous solution onto rigid or flexible substrates, thus making them quite appealing for the fabrication of low-cost electronic devices. While these devices are expected to consist of NC solids, with the expectation that the properties of such solids will be much improved over the combined properties of the individual NCs, key questions exist regarding the conduction properties of such thin films. Scanning tunnelling microscopy is an ideal tool to characterize individual NCs. Generally the NCs have to be attached to a conducting substrate to get stable substrate/NC/tip junction, but here we will show that NCs are better stabilized in the tunnelling junction between a tip and a conductive substrate, when they self-assemble to form a monolayer of nanocrystals. By using scanning tunnelling spectroscopy at low temperatures, we will investigate the transport through individual nanocrystals in the monolayer and show that tunnelling currents with higher intensities are driven through the NCs in a monolayer with respect to the tunnelling currents used on isolated NCs. From theoretical calculations, we will discuss the origin of the linewidth for the resonances observed in the differential conductance spectra. Depending on the chemical nature of the NCs, different mechanisms, including a strong electron-phonon coupling, a large intervalley coupling or a variable degree of electronic coupling between the NCs, are found to be involved in the broad resonances with widths in the range of tens of meV.

PHYS Poster Session - Nanostructured Materials and Nanophotonics
7:30 PM-10:00 PM, Wednesday, April 9, 2008 Morial Convention Center -- Hall A, Poster

Division of Physical Chemistry

The 235th ACS National Meeting, New Orleans, LA, April 6-10, 2008