BP 18: Functionalized Nanoparticles

Time: Wednesday 14:00–15:15 Location: H43

BP 18.1 Wed 14:00 H43

Phosphorescence quenching in the vicinity of gold nanoparticles — •Thomas Soller[1], Moritz Ringler[1], Thomas Arno Klar[1], Jochen Feldmann[1], Michael Wunderlich[2], Yvonne Markert[2], Hans-Peter Josel[2], Alfons Nichtl[2], and Konrad Kürzinger[2] — [1]Photonics and Optoelectronics Group, Department of Physics and CeNS, Ludwig-Maximilians-Universität München — [2]Roche Diagnostics GmbH, Nonnenwald 2, Penzberg

Gold nanoparticles alter the radiative and nonradiative decay rates of nearby dye molecules, resulting either in a decreased or increased luminescence intensity. While the effects of gold nanoparticles on surrounding fluorophores have been investigated thoroughly, there are no corresponding studies dealing with the influence of gold nanoparticles on the luminescent properties of phosphors. Especially for applications in biosensing, phosphors are particularly suitable, as they allow to cut off autofluorescence.

We have investigated the influence of gold nanoparticles on the radiative and nonradiative decay rates of two different phosphorescent dyes. The phosphors are attached to the nanoparticles via a biomolecular recognition reaction. Time-resolved luminescence spectroscopy reveals an increase of the radiative as well as the nonradiative rate in all regarded phosphor/gold nanoparticle hybrid systems. The increase in the radiative rate is outweighed by the more prominent enhancement in the nonradiatve rate, thus a luminescence quenching occurs.

BP 18.2 Wed 14:15 H43

Nanodiamonds as Photostable Fluorophoric Lable in Living Cells — •Felix Neugart, Carsten Tietz, Fedor Jelezko, and Jörg Wrachtrup — 3. Physical Institute, Pfaffenwaldring 57, University of Stuttgart, 70550 Stuttgart

Many processes in living cells could be promoted by investigation on a single molecule level such as single particle tracking. Dye molecules, especially auto fluorescent proteins, are limited by photobleaching, semiconductor quantum dots are toxic for cells. Nanodiamonds are non-toxic and show a bright non bleaching fluorescence. The origin of the fluorescence are colour centres, these are defects in the diamond lattice. The surface can be functionalized to bind to proteins or other particles of interest. With a size of down to 5 nm nanodiamonds are comparatively small. For our experiments we prepared diamonds (50 nm and 125 nm crystallites) with NV-centres emitting around 700 nm where living cells show a low autofluorescence. Defects at the surface of the nanodiamonds cause aggregation of the diamonds in physiological buffer solutions. To clean the surface of the nanodiamonds from graphite and other impurities the crystallites were penetrated by strong acids. Acid treated nanodiamonds stay in the buffer in stable colloidal solution. We inserted the nanodiamonds into cells by microinjection or by endocytosis. The diamonds could be detected by fluorescence as well as refraction.

BP 18.3 Wed 14:30 H43

Core-Shell Nanoparticle Layers for Label-Free Biosensing in Array Format — •Reiner Dahint[1], Elka Trileva[1], Hatice Acunman[1], Ulrike Konrad[1], Martin Zimmer[1], Volker Stadler[2], and Michael Himmelhaus[1] — [1]Angewandte Physikalische Chemie, Universität Heidelberg — [2]DKFZ Heidelberg

A novel complex material has been prepared with combined biological and optical functionalities. It consists of biofunctionalized gold-coated nanoparticles self-assembled on surfaces, which locally change their optical absorption properties in response to biospecific interactions. For the preparation of the layers, nanoparticles of about 400 nm in diameter are self-assembled on a gold-coated substrate to form a random-close-packed monolayer. Afterwards, the nanoparticle layer is covered with a metal film by deposition of gold colloid prior to an electroless plating step. The resulting surface exhibits a pronounced optical extinction upon reflection of white light. When organic molecules bind to the surface, the peak position of this extinction shows a strong red-shift. It is demonstrated that sensitivity towards molecule adsorption can be significantly enhanced compared to conventional surface plasmon resonance based techniques. By immobilizing a pattern of different peptides on the nanoparticle layers and reacting the surface with specific antibodies label-free detection of biospecific interactions in array format has been shown. In the future we intend to immobilize high-density peptide libraries on the nanoparticle layers by combinatorial synthesis to facilitate in situ, parallel, time-resolved, and label-free screening of biospecific binding processes.

BP 18.4 Wed 14:45 H43

Polymer-coated inorganic nanocrystals with a defined number of functional groups — •Ralph Sperling, Marco Zanella, and Wolfgang Parak — Ludwig-Maximilians-Universität München, Center for NanoScience, Amalienstr. 54, 80799 München, Germany

Inorganic hydrophobic nanoparticles of different materials such as Au, CdSe/ZnS, CoPt etc. can be coated with an amphiphilic polymer to yield particles that are stable in aqueous solution.

The carboxylic groups on the surface of the polymer shell serve as anchor points for further chemical functionalization. Ligand molecules with amino groups can be covalently bound to the particles. Poly(ethylene glycol) (PEG) is an inert biocompatible polymer that is known to decrease unspecific binding of particles to surfaces and to increase the colloidal stability at physiological salt concentrations. With bifunctional PEG molecules, the particles can be modified with additional functional groups such as amines, thiols, maleimides etc.

By the increase in size, the binding of the PEG molecules to the particles can be monitored by gel electrophoresis and other techniques. If the molecular weight of the PEG molecule is high enough, conjugates of nanoparticles with one, two, and three PEG molecules per nanoparticle can be separated using gel electrophoresis. In this way the PEG molecules act as spacers that allow the sorting of nanoparticles with a discrete number of functional groups, in order to eliminate uncontrolled inter-particle crosslinking in further experiments.

BP 18.5 Wed 15:00 H43

Surface-enhanced Raman scattering (SERS) in single gold nanoparticle dimers — •Moritz Ringler[1], Alexander Schwemer[1], Joachim Stehr[1], Alfons Nichtl[2], Konrad Kürzinger[2], Gunnar Raschke[1], Richard T. Phillips[3], Thomas A. Klar[1], and Jochen Feldmann[1] — [1]Photonics and Optoelectronics Group, Physics Department and CeNS, Ludwig-Maximilians-Universität, 80799 Munich, Germany — [2]Roche Diagnostics GmbH, Nonnenwald 2, D-82372 Penzberg, Germany — [3]Cavendish Laboratory, University of Cambridge, Madingley Road, Cambridge CB3 0HE, United Kingdom

We have used protein-ligand interaction to link gold nanoparticles to dimers that have a well-defined SERS hot spot in the inter-particle gap. The dimer geometry is observed through Rayleigh scattering while the hot spot is probed via Raman spectroscopy. Surface-enhanced Raman emission from the dimer hot spot can be excited when the polarization of the Raman laser beam is parallel to the dimer axis. SERS spectra fluctuate both in shape and amplitude, and Raman emission and Rayleigh scattering spectra are strongly correlated.