

CPP 4: Focus Session "Nanoparticles, Nanocrystals and Colloids" (jointly with MA)

Time: Monday 10:15–13:00

Location: HSZ 103

Topical Talk CPP 4.1 Mon 10:15 HSZ 103
Magnetic nanoparticles: fundamentals and applications — ●ANDREAS HÜTTEN — Physics of Nanostructures, Department of Physics, Bielefeld University

Our contribution highlights recent advances in synthesis, characterization, self-assembly and sensing applications of monodisperse magnetic Co and Co based alloyed nanoparticles. A brief introduction into solution phase synthesis techniques as well as the magnetic properties and aspects of the self-assembly process of nanoparticles will be given with the emphasis placed on selected applications. Here, the presentation focuses on: - Combining magnetic nanoparticles with XMR-sensor technology - Fabrication of granular magnetoresistive sensors by employment of particles themselves as sensing layers - Employing magnetic nanoparticles as reconfigurable materials in lab-on-a-chip devices.

Topical Talk CPP 4.2 Mon 10:45 HSZ 103
Directing the Self-Assembly of Nanoparticles — ●ALEXANDER BÖCKER — DWI an der RWTH Aachen e.V. — Lehrstuhl für Makromolekulare Materialien und Oberflächen, RWTH Aachen

This talk deals with the use of different interfaces as templates for the self-assembly of various colloidal particles. First, we describe classical oil/water emulsion systems, the so-called Pickering Emulsions. Here, the controlled nanoparticle assembly can lead to permeable, yet robust membranes and capsules. Furthermore, fluid interfaces as found in block copolymer nanostructures can be employed. Here, the nanoparticles may impart specific functions to the nanostructures, such as magnetism or charge transport as required in magnetic data storage media or polymer-based photovoltaic devices, respectively.

Moreover, we demonstrate that wrinkled polydimethylsiloxane (PDMS) substrates, with wavelengths on the order of only a few hundred nanometers, guide the assembly of rod-like tobacco mosaic virus (TMV) nanoparticles or spherical microgels. Wrinkled substrates with pre-aligned nanoparticles are used as inked stamps to transfer large particle arrays onto flat substrates. The characteristic spacing and form of the structures can be controlled by the properties of the stamp.

Topical Talk CPP 4.3 Mon 11:15 HSZ 103
Magnetic Fluids - Properties and Applications — ●STEFAN ODENBACH — TU Dresden, Chair of Magnetofluidynamics, 01062 Dresden

Suspensions of magnetic nanoparticles in appropriate carrier liquids - so called ferrofluids - exhibit normal liquid behaviour coupled with superparamagnetic properties. The use of appropriate surfactants for the particles enables longterm stabilisation of the suspensions making them suitable for numerous technical and even medical applications.

The peculiarity of ferrofluids is given by the fact that moderate magnetic fields in the order of 10mT can significantly change the fluids properties - e.g. their viscosity - and can also provide the possibility to control the flow of such fluids.

Within the presentation a general (partly experimental) introduc-

tion of ferrofluids, their properties and applications will be followed by a discussion of magnetic flow control for biomedical applications of ferrofluids. This problem - actually discussed within the frame of novel cancer therapies - enlightens the strong interdisciplinarity of ferrofluid research covering fields from chemistry over physics and engineering towards medicine.

15 min. break

Invited Talk CPP 4.4 Mon 12:00 HSZ 103
Semiconductor nanocrystals — ●ANDREY ROGACH — City University of Hong Kong

Semiconductor nanocrystals of essentially every composition can nowadays be synthesized in large quantities by inexpensive and versatile solution based approaches. They are attractive objects for use as building blocks in different functional nanostructures. We provide an overview of strongly emissive semiconductor nanocrystals synthesized in our labs and demonstrate several approaches for nanocrystals assembly. Advanced optical spectroscopy provides important insights into fundamental photophysical properties of semiconductor nanostructures. Different application aspects of functional structures based on semiconductor nanocrystals ranging from energy transfer structures to biological markers will be discussed.

Topical Talk CPP 4.5 Mon 12:30 HSZ 103
Ion and pH sensing with colloidal nanoparticles: tailoring hybrid FRET-based nanobiosensors — ●MARTIN OHEIM — Centre National de la Recherche Scientifique, CNRS UMR8154; Institut National de la Santé et de la Recherche Médicale - INSERM U603; Université Paris Descartes, Laboratory of Neurophysiology & New Microscopies

In biological cells, the free cytoplasmic ion concentration ($[Ca^{2+}]_i$) plays important roles in a plethora of intracellular signalling cascades. One way to attain specificity and to increase the bandwidth of Ca^{2+} signaling is the confinement of excursions of $[Ca^{2+}]_i$ from baseline to micro- and nanoscale domains. Due to their ephemeral nature (nm scale, ms kinetics) the experimental detection of Ca^{2+} microdomains has presented a major challenge to microscopists. In my contribution I will present ongoing efforts of a franco-german-american 'nanoFRET' consortium that aims at conceptualizing, designing, validating and using novel hybrid nano-particle/organic dye-based nanobiosensors for the detection of intracellular ion-concentration nanodomains. After a swift motivation of our "pointillistic" imaging approach and the presentation of the general sensor concept, I will discuss how core/shell properties, donor-acceptor distance, stoichiometry and surface effects affect sensor performance. Preliminary sensing applications of Ca^{2+} and protons will be presented. I shall equally discuss the challenges for loading and imaging single-nanoparticle in live cells and ways to address these.