star-shaped gold nanoparticles coated with self-assembled monolayers of 4-mercaptobenzoic acid. SERS is observed without the formation of gold nanoparticle aggregates or resonant excitation of the analyte. Total Raman scattering enhancement factors for single nanostars are comparable to those of nanoparticle assemblies exhibiting coupled plasmon resonances. This renders gold nanostars promising for Raman imaging applications in complex environments such as cells or membranes.

O 54.9 Thu 17:00 SCH A216

Enhanced LED emission by metal nanoparticles — •Tino Göhler[1], Andreas Hille[1], Stefan Grafström[1], Lukas M. Eng[1], and Reiner Windisch[2] — [1]Technische Universität Dresden, 01069 Dresden, Germany — [2]OSRAM Opto Semiconductors GmbH, 93055 Regensburg, Germany

The external quantum efficiency of light emitting-diodes (LEDs) based on AlGaAs is limited by internal total reflection because of the of high refractive index (n=3.6). Metal nanoparticles (MNPs) can be used as dipole scatterers in order to enhance the emission of LEDs.

We investigate the enhancement produced by single gold MNPs onto red LEDs ($\lambda_{emission}$ = 645 nm FWHM=20 nm) by using a confocal imaging set-up. The enhancement depends strongly on the particle size and on the surrounding medium (air n=1.0, immersion oil n=1.5). While in air particles of all sizes investigated (80-150 nm) enhance the LED emission, we observed a strong size dependence when embedding the particle in immersion oil. Here, the surrounding medium shifts the plasmon resonance of the particles such that it overlays the LED emission spectrum for larger particles. Then absorption leads to suppression rather than enhancement of the emission.

O 54.10 Thu 17:15 SCH A216

Phase contrast imaging in near-field superlensing — •Thomas Taubner[1,2], Jon Schuller[2], Mark Brongersma[2], Chris Fietz[3], Gennady Shvets[3], and Rainer Hillenbrand[4] — [1]I. Physikalisches Institut, RWTH Aachen, Germany — [2]Department of Material Science, Stanford University, USA — [3]Department of Physics, UT Austin, USA — [4]Max-Planck-Institut für Biochemie, Martinsried, Germany

Here we study the optical imaging properties of novel near-field imaging device called a SiC superlens. A superlens is a planar device that allows for subwavelength imaging by employing coupled surface waves on a thin slab of a negative-permittivity material. As opposed to previous intensity-only measurements, we now perform amplitude and phase-measurements of the near-fields in the image plane of a superlens by mapping the field distribution with a scattering-type near-field optical microscope (s-SNOM). When investigating the spectral properties of the SiO2/SiC/SiO2 superlens, we observe a sign change in the phase of the transmitted near-fields when tuning the illumination wavelength over the superlenses resonance condition.

This change will be explained by the dispersion relation of the superlens, in combination with a fundamental interference effect. When operating a superlens off-resonance, the interference of evanescent fields causes the intensity contrast to decrease. This can be compensated for with phase-sensitive imaging to practically maintain the spectral range of high-resolution operation. Our results are important for future spectroscopic applications of superlenses and other devices such as hyperlenses or 2D plasmon lenses.

O 54.11 Thu 17:30 SCH A216

Spectroscopy of Individual "Artificial Atoms" — •Martin Husnik[1], Nils Feth[1,2], Matthias Wolfram Klein[1], Michael König[3], Jens Niegemann[3], Kurt Busch[2,3], Stefan Linden[1,2], and Martin Wegener[1,2] — [1]Institut für Angewandte Physik, Universität Karlsruhe (TH), 76131 Karlsruhe, Germany — [2]Institut für Nanotechnologie, Forschungszentrum Karlsruhe in der Helmholtz-Gemeinschaft, 76021 Karlsruhe, Germany — [3]Institut für Theoretische Festkörperphysik, Universität Karlsruhe (TH), 76131 Karlsruhe, Germany

Metamaterials exhibiting a magnetic response at optical wavelengths have recently attracted much attention [1]. The magnetic response depends on both the design of the individual building blocks ("artificial atoms") and on electromagnetic coupling effects between the "artificial atoms". Thus for future developments, investigation of the individual "artificial atoms" is crucial.

Here, we present absolute extinction cross-section spectra of individual split-ring resonators (SRR) measured by means of a modulation technique [2,3]. The extinction cross-section at the fundamental magnetic resonance is found to be eight times the geometrical area covered by the SRR. The experimental results are in excellent agreement with microscopic calculations and can be understood by a simple electric-circuit model.

[1] V. M. Shalaev et al., Nature Photon. **1**, 41 (2007).
[2] A. Arbouet et al., Phys. Rev. Lett. **93**, 127401 (2004).
[3] M. Husnik et al., Nature Photon. **2**, 614 (2008).

O 54.12 Thu 17:45 SCH A216

Transform limited focusing of few cycle optical pulses using all-reflective optics — •Diyar Sadiq, Bjoern Piglosiewicz, Manfred Maschek, Wjatscheslaw Schmidt, Robert Pomraenke, Parinda Vasa, and Christoph Lienau — Institut für Physik, Carl von Ossietzsky Universität, 26129 Oldenburg, Germany

The availability of high-intensity few-cycle optical pulses from turn-key laser oscillators is important for various applications in the emerging field of extreme nonlinear optics. This requires focussing few-cycle pulses down to - or even beyond - the diffraction limit. Using conventional microscope objectives this is highly challenging due to their complex spatio-temporal dispersion properties. All-reflective objectives, minimizing chromatic dispersion, are expected to have much more favorable focussing characteristics. So far, however, little is known about the spatio-temporal distribution of electromagnetic fields of few-cycle pulses in the focus of such an all-reflective-objective. Here, we demonstrate focussing 6-fs, 2.25-cyle optical pulses from an 80-MHz repetition rate Ti-sapphire oscillator down to a diffraction-limited spot size of less than 1 μm while maintaining the pulse duration. Three-dimensional mapping of the spatial intensity profile near the focus is performed using a scanning near-field optical microscope. The time profile of the focussed pulse is characterizing by interferometric autocorrelation measurements using second harmonic generation or - with sub-100-nm spatial resolution - using electron generation at sharp metallic tips. Progress towards direct space- and time-resolved electric field measurements will be reported.

O 54.13 Thu 18:00 SCH A216

Near-field radiative heat transfer between a spheroid and a surface — •Oliver Huth, Felix Rüting, and Svend-Age Biehs — Institut für Physik, Carl von Ossietzky Universität Oldenburg

A near-field scanning thermal microscope has been developed at Oldenburg University. This instrument measures the heat transfer between the tip of a sensor and the surface of a sample with a different temperature at nanometer distances. Our objective is to describe this near-field heat transfer theoretically, and to compare the theory to the measured data. To this end, the foremost part of the sensor can be modelled as a small sphere. Then the heat transfer between the sphere and the sample is calculated within the framework of Rytov's fluctuational electrodynamics. Actually, however, the shape of the senor's tip deviates from a sphere, which requires more refined strategies for modelling the tip. An analytically tractable generalisation of the sphere model is obtained by considering general spheroids, which allows one to assess the influence of the tip's shape on the magnitude of the heat transfer. In this talk we present first results of such calculations, together with comparisons to results given by the sphere model.

O 54.14 Thu 18:15 SCH A216

Near-field radiative heat transfer between a sphere and a nano-structured surface — •Felix Rüting, Oliver Huth, and Svend-Age Biehs — Institut für Physik Carl von Ossietzky Universität Oldenburg

We study the near-field radiative heat transfer between a probe and a structured sample at nanometer distances. The probe is modeled as a nanosphere by means of a dipole model, while the surface of the sample is treated by a perturbative ansatz based on the Rayleigh hypothesis and the Ewald-Oseen theorem. We obtain characteristic signatures of the heat transfer between a sphere and a simple model geometry, computed numerically up to the second order in the profile. The validity of the approximations employed is ascertained. Furthermore, we show that signals measured with a near-field scanning thermal microscope (NSThM) operated in constant-distance mode are in good qualitative agreement with the theoretical results already to the first order in the surface profile, even though the theoretical model is subject to restrictions which are not obeyed in the experiment.