MAR13-2012-020811

Abstract for an Invited Paper
for the MAR13 Meeting of
the American Physical Society

Optical Spectroscopy of Single Gold Nanoparticles

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Compared to electron microscopy or to scanning probe microscopy, the optical selection of individual nanoparticles in a far-field microscope provides non-invasive probing of deep layers and commands a wide range of time-resolved and frequency-resolved techniques. Optical signals provide unique insights into the dynamics of nano-objects and of their surroundings [1]. I shall illustrate applications of single-nanoparticle optics with recent topics from our group. i) We study single gold nanoparticles by photothermal and pump-probe microscopy [2]. These experiments can be done in an optical trap, where a single nanorod orients along the trapping polarization, and studied the acoustic damping of gold nanoparticles. ii) Photothermal microscopy opens the study of non-fluorescent absorbers, down to single-molecule sensitivity [3]. Combining photothermal contrast with photoluminescence, we can measure the luminescence quantum yield on a single-particle basis. Moreover, the high signal-to-noise ratio opens up uses of individual gold nanoparticles for local plasmonic and chemical probing, down to single-protein level [4]. iii) Gold nanorods generate strong field enhancements near their tips. By matching the rod's aspect ratio to a dye's fluorescence and excitation spectra, we could observe thousand-fold enhancements for the fluorescence of single Crystal Violet molecules [5]. Gold nanorods can produce local fields as high as those of bow-tie antennas, thanks to their narrow plasmon resonance, but they are much easier to synthesize, functionalize and disperse in solution than lithographically made nanostructures. Acknowledgement : The work presented was done over the last 7 years by F. Kulzer, M. Lippitz, A. Tchebotareva, A. Gaiduk, P. Zijlstra, S. Khatua, M. A. van Dijk, P. V. Ruijgrok, M. Yorulmaz, HF. Yuan, and N. Verhart in the author's group.

[1] F. Kulzer et al., Angew. Chem. **49** (2010) 854.
[2] A. L. Tchebotareva et al., Laser Photon. Rev. **4** (2010) 581-597.
[3] A. Gaiduk et al. Science **330** (2010) 353
[4] P. Zijlstra et al., Nature Nanotech. **7** (2012) 379.
[5] HF. Yuan et al., Angew. Chem., in press (2013).