

RESEARCH FIELDS

In Tübingen I have established a very comprehensive research program with two main topics: 1) optical single molecule spectroscopy (fluorescence, Raman scattering), including also quantum dots and gold nanoparticles and 2) multimodal tip/plasmon enhanced near-field optical microscopy and spectroscopy in the spectral and time domain, respectively.

Single molecule optical spectroscopy: I began optical single molecule detection, imaging and spectroscopy at ambient conditions in 1993 with my home-built near field optical microscope and aperture tips when I was a junior group leader with the Institute of Physics at the University of Basel. In 2001 we have introduced the concept of radially and azimuthally polarized excitation in confocal microscopy to determine 3D orientation of the transition dipole moments of single molecules from confocal excitation patterns. In 2005 we have introduced tunable $\lambda/2$ -Fabry-Pérot resonators to single-molecule/particle spectroscopy to control radiative rates, Förster energy transfer and the fluorescence quantum yield or localize single luminescent beads with 10 nm precision.

10 important publications of the last 10 years:

- Strong and Coherent Coupling of a Plasmonic Nanoparticle to a Subwavelength Fabry-Pérot Resonator, A Konrad, AM Kern, M Brecht, AJ Meixner, Nano Lett 15 (7), 4423-4428 (2015)
- Coupling single quantum dots to plasmonic nanocones: optical properties AJ Meixner, R Jäger, S Jäger, A Bräuer, K Scherzinger, J Fulmes, et al. Faraday Discuss 184, 321-337 (2015)
- Controlling the dynamics of Förster resonance energy transfer inside a tunable sub-wavelength Fabry-Pérot-resonator, A Konrad, M Metzger, AM Kern, M Brecht, AJ Meixner, Nanoscale 7 (22), 10204-10209 (2015)
- Measurement of Vibrational Modes in Single SiO₂ Nanoparticles Using a Tunable Metal Resonator with Optical Subwavelength Dimensions, AI Chizhik, AM Chizhik, AM Kern, T Schmidt, K Potrick, F Huisken, AJ Meixner, Phys. Rev. Lett. 109 (22), 223902 (2012)
- Probing the radiative transition of single molecules with a tunable microresonator, AI Chizhik, AM Chizhik, D Khoptyar, S Bär, AJ Meixner, J Enderlein, Nano Lett 11 (4), 1700-1703 (2011)
- Excitation isotropy of single CdSe/ZnS nanocrystals, AI Chizhik, AM Chizhik, D Khoptyar, S Bär, AJ Meixner, Nano Lett 11 (3), 1131-1135 (2011)
- Three-Dimensional Orientation of Single Molecules in a Tunable Optical $\lambda/2$ Microresonator, R Gutbrod, D Khoptyar, M Steiner, AM Chizhik, AI Chizhik, S Bär, AJ Meixner, Nano Lett 10 (2), 504-508 (2010)
- Imaging and Spectroscopy of Defect Luminescence and Electron-Phonon Coupling in Single SiO₂ Nanoparticles, AM Chizhik, AI Chizhik, R Gutbrod, AJ Meixner, T Schmidt, J Sommerfeld, F Huisken, Nano Lett 9 (9), 3239-3244 (2009)
- Tuning the fluorescence emission spectra of a single molecule with a variable optical subwavelength metal microcavity, A Chizhik, F Schleifenbaum, R Gutbrod, A Chizhik, D Khoptyar, AJ Meixner, J Enderlein, Physical Rev Lett 102 (7), 073002 (2009)
- Orientational imaging of subwavelength Au particles with higher order laser modes, AV Failla, H Qian, H Qian, A Hartschuh, AJ Meixner, Nano Lett 6 (7), 1374-1378 (2006)

Multimodal tip enhanced near-field optical microscopy & spectroscopy with a spatial resolution down to four nanometers: We have introduced a high NA parabolic mirror to near-field optical microscopy and radially polarized illumination for perfect diffraction limited plasmon excitation along the tip axis of a sharp probe tip. We have shown that a parabolic mirror can provide a strictly diffraction limited focal volume, ideal for confocal microscopy. A confocal microscope based on a parabolic mirror hence provides the highest possible signal collection efficiency and with a minimum background.

10 important Publications of the last 10 years:

- Revealing nanoscale optical properties and morphology in perfluoropentacene films by confocal and tip-enhanced near-field optical microscopy and spectroscopy, X Wang, K Broch, F Schreiber, AJ Meixner, D Zhang, *PhysChemChemPhys* 18 (23), 15919-15926 (2016)
- Enhancement of Radiative Plasmon Decay by Hot Electron Tunneling X Wang, K Braun, D Zhang, H Peisert, H Adler, T Chassé, AJ Meixner *ACS Nano* 9 (8), 8176-8183 (2015)
- Superluminescence from an optically pumped molecular tunneling junction by injection of plasmon induced hot electrons, K Braun, X Wang, AM Kern, H Adler, H Peisert, T Chassé, D Zhang, AJ Meixner, *Beilstein J. Nanotech.* 6, 1100 (2015)
- Au nanotip as luminescent near-field probe, S Jäger, AM Kern, M Hentschel, R Jäger, K Braun, D Zhang, H Giesen, AJ Meixner, *Nano Lett* 13 (8), 3566-3570 (2013)
- Simultaneous Spectroscopic and Topographic Near-Field Imaging of TiO₂ Single Surface States and Interfacial Electronic Coupling, PC Sevinc, X Wang, Y Wang, D Zhang, AJ Meixner, HP Lu, *Nano Lett* 11 (4), 1490-1494 (2011)
- High-Resolution Spectroscopic Mapping of the Chemical Contrast from Nanometer, Domains in P3HT: PCBM Organic Blend Films for Solar-Cell Applications, X Wang, D Zhang, K Braun, HJ Egelhaaf, CJ Brabec, AJ Meixner, *Adv Funct Mater* 20 (3), 492-499 (2010)
- Nanoscale spectroscopic imaging of organic semiconductor films by plasmon-polariton coupling, D Zhang, U Heinemeyer, C Stanciu, M Sackrow, K Braun, LE Hennemann, X Wang, R Scholz, F Schreiber, AJ Meixner, *Phys. Rev. Lett.* 104 (5), 056601 (2010)
- Tighter focusing with a parabolic mirror, J Stadler, C Stanciu, C Stupperich, AJ Meixner, *Optics Lett.* 33 (7), 681-683 (2008)
- Imaging Nanometre-Sized Hot Spots on Smooth Au Films with High-Resolution Tip-Enhanced Luminescence and Raman Near-Field Optical Microscopy, M Sackrow, C Stanciu, MA Lieb, AJ Meixner, *ChemPhysChem* 9 (2), 316-320 (2008)