

DS 38: Vibrational Spectroscopy of Nanolayers with Optical Probes

Time: Friday 15:15–16:45

Location: H 2013

Invited Talk

DS 38.1 Fri 15:15 H 2013

Vibrational dynamics on the nanoscale — ●MARKUS RASCHKE — Department of Chemistry, University of Washington, Seattle, USA

As the spatial dimensions of a medium shrink into the 1 to 100 nm range, concomitant changes in the time scales of the fundamental optical excitations can occur. Here, by combining scattering-type scanning near-field optical microscopy with ultrafast spectroscopy techniques provides simultaneous nanometer spatial and femtosecond temporal resolution. Using transient IR pulses we demonstrate spatio-temporal imaging of block-copolymer nanostructures. The vibrational free-induction decay probed in the optical near-field of the respective molecular subensembles carries information about spatial coherence and intermolecular coupling. In addition, the influence of the tip as an optical antenna on the radiative rates of the induced tip-sample polarization will be discussed.

Invited Talk

DS 38.2 Fri 15:45 H 2013

UHV-based TERS on adsorbed molecules — ●BRUNO PETTINGER and JENS STEIDTNER — Fritz-Haber-Institut der MPG, Faradayweg 4-6, D-14195 Berlin

In recent years tip-enhanced Raman spectroscopy (TERS) has proven to be a feasible tool for the local investigation of surfaces on a nanometer scale, in some cases with single molecule sensitivity [1]. So far, TERS experiments were performed in the gas phase and under atmospheric pressure, which entails some disadvantages as e.g. the possible contamination of the tip and the sample. Here we present a novel microscope based on a high-numerical parabolic mirror for focusing the laser to a minimum size spot and collecting the scattered light. The SPM and the essential optical components are combined on a rigid platform, which is mounted in an UHV system. Optical fibers

connect this setup with remote laser and spectrograph. The focusing of the laser onto the tip apex and maximizing the scattered intensity is achieved by a five-axis alignment of the parabolic mirror by piezomotors. For dye adsorbates on smooth Au(111) samples, the approach of a STM tip boosts the Raman scattering signal from a small region with a diameter of only a few nanometers to a 4000-fold level, which means an underlying enhancement of TERS of 10^6 - 10^7 . This huge enhancement causes in UHV only a minor photodecomposition, much in contrast to comparable experiments in air, and thus allows to move toward single molecule spectroscopy and microscopy. Preliminary results on this topic will be presented.

1. K.F. Domke et al., J. Am. Chem. Soc. 128, 14721 (2006).

Invited Talk

DS 38.3 Fri 16:15 H 2013

Tip enhanced Raman scattering on biological samples — ●VOLKER DECKERT — ISAS - Institute for Analytical Sciences, Dortmund, Germany

Recently optical techniques that reveal lateral resolution well beyond the diffraction limit became more and more accessible. In particular the combination of near-field optics and Fluorescence spectroscopy proved to be very successful. Since Raman spectroscopy is a comparable insensitive spectroscopic technique progress here was much slower. Just with the combination of field-enhancing techniques, near-field optical techniques could be combined with Raman methods. Especially Tip-Enhanced Raman Scattering (TERS) is a technique that uniquely combines the best of the two worlds. Her applications on biological samples ranging from single cells, single virus particles, to single molecules will be shown. Thus demonstrating the capabilities of TERS. Specifically TERS experiments on a single RNA strand will be discussed and the issue of direct label free sequencing of DNA will be addressed.