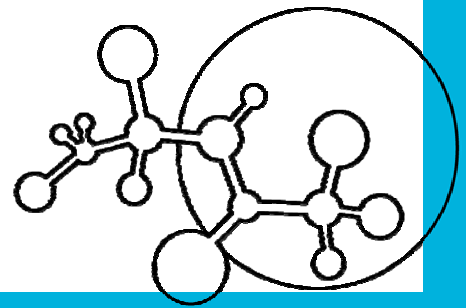




# FRIAS

FREIBURG INSTITUTE FOR ADVANCED STUDIES  
ALBERT -LUDWIGS -UNIVERSITÄT FREIBURG  
SCHOOL OF SOFT MATTER RESEARCH



## Quantum Efficiency Seminar and Colloquium Alexander Weber-Bargioni

### Molecular Foundry, Lawrence Berkeley Nat. Laboratory Investigating properties of nano structured materials optically and electronically with spatial resolutions on and below the single digit nm scale

The scientific interest in my group is to study the efficiency determining parameters of nano-structured light harvesting materials at the length scales associated with opto electronic processes. Therefore we study optically accessible material properties and correlate them to the material's local electronic structure.

The largest technical challenge for this work is to perform optical spectroscopy with a spatial resolution well below the diffraction limit to resolve and distinguish nano structured materials. In my presentation I will report on a significant step towards this goal, using novel nanofabricated optical antenna tips capable of performing optical spectroscopy with a spatial resolution below 20nm. Optical antennae are individual or coupled metal nano particles (Au or Ag for the visible part of the electromagnetic spectrum) that couple with high efficiency the free propagating electromagnetic wave to a surface plasmon polariton. These nano antennae represent cavities for these surface plasmon polaritons that create if excited at resonance a highly localized (down to 10nm) and enhanced optical near field. We are able to reproducibly fabricate these optical antennae on scanning probe tips as next generation near field optical probes. This enabled us to record useful Raman spectra on Carbon Nano Tubes in ~50 ms to acquire 256 by 256 pixel images on dielectric substrates with a full spectrum at each pixel. This so called hyperspectral Raman imaging leads to chemical maps with a spatial resolution below 20nm. Additionally we investigated the local excitation properties of InP nanowires via hyperspectral Photo Luminescence Spectroscopy using these novel optical antenna tips.

The local electronic structure of nano materials we determine via Scanning Tunneling Microscopy/Spectroscopy (STM/STS) with atomic resolution. In my presentation I will show the electronic structure of individual bio molecules that are involved in photoelectric processes in nature, adsorbed on metal substrates. Using differential conductive mapping the varying spatial extend of the frontier orbitals (both occupied and unoccupied) can be illustrated.

In the last part of my presentation I will briefly discuss a specific light harvesting system that we will study using both techniques to correlate electronic structure with optical accessible parameters such as the local excitation efficiency and local photocurrent generation efficiency.

**Date:** Tuesday, July 19<sup>th</sup>, 2011 2:15 pm

**Location:** FRIAS Seminar Room, Albertstr. 19, Freiburg

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Contact: Andreas Buchleitner, Institute of Physics, Quantum Optics and Statistics,  
T +49 761 203 5929 F +49 761 203 5967 E [beate.spingler@frias.uni-freiburg.de](mailto:beate.spingler@frias.uni-freiburg.de)  
[www.physik.uni-freiburg.de](http://www.physik.uni-freiburg.de)

Physikalisches Institut

Albert-Ludwigs-  
Universität Freiburg