# Colloquium Nanophotonique

## Plasmon enhanced light emission from an optically pumped tunneling junction


Alfred J. Meixner

*Institute of Physical and Theoretical Chemistry and LISA+, University of Tübingen*
E-mail: alfred.meixner@uni-tuebingen.de



Ultra-small light sources which can be controlled electrically or optically are of great interest in various fields of nanoscience ranging from local spectroscopy to plasmonics and photonics. The emission of photons from an STM-junction is such an example, however hampered due to small quantum efficiency. The emission of photons from a tunneling junction can be enhanced by almost three orders of magnitudes by optically pumping a gap-plasmon oscillation with a threshold behavior as the applied voltage is increased. Either a pristine Au-substrate/Au-tip tunneling junction or a molecular junction (Au-substrate/self-assembled molecular monolayer/Au-tip) with molecules chemically bound to the Au substrate is used. Analyzing the emission spectra from the junction recorded as a function of bias voltage for the Au-Au junction we conclude that the enhanced intensity is induced by laser illumination and originates from the radiative decay of hot electrons closely above the Fermi level via inelastic tunneling into the plasmon modes formed by the tip-substrate gap.

In the presence of molecules in the gap, we observe a bias dependent spectral narrowing characteristic for superluminescence. The optically pumped molecular junction behaves as a bias-driven point source, operating at ambient conditions and providing almost three orders of magnitude higher electron-to-photon conversion efficiency than electroluminescence induced by inelastic tunneling without optical pumping. The enhanced emission can be modeled by rate equations taking into account the hole-injection from the tip (anode) into the highest occupied orbital of the closest substrate bound molecule (lower level) and radiative recombination with an electron from above the Fermi-level (upper level), hence feeding photons back by stimulated emission resonant with the gap mode. Our study contributes to the fundamental understanding of quantum plasmonics and may lead to new applications in actively controlled photonics devices.


AUDITORIUM
Institut d'Optique
2 Av Fresnel, 91127 Palaiseau

**Vendredi 5 Mai 2017 à 10h30**