Electro-Optical Antennas as Single Photon Sources

Lukas Novotny, Markus Parzefall and Palash Bharadwaj
ETH Zurich, Photonics Laboratory, 8093 Zurich, Switzerland.
lnovotny@ethz.ch

Optical antennas consisting of plasmonic materials provide extreme light localization and small mode volumes, thereby boosting the sensitivity and signal-to-noise ratio in applications ranging from single photon sources to photodetection.

However, most of the optical antennas studied to date operate on a light-in / light-out basis. To directly convert low-energy electrons into propagating photons we study plasmon mediated two-step momentum downconversion. Surface plasmon polaritons (SPPs) are excited by low-energy electron tunneling and then converted to free-propagating photons.

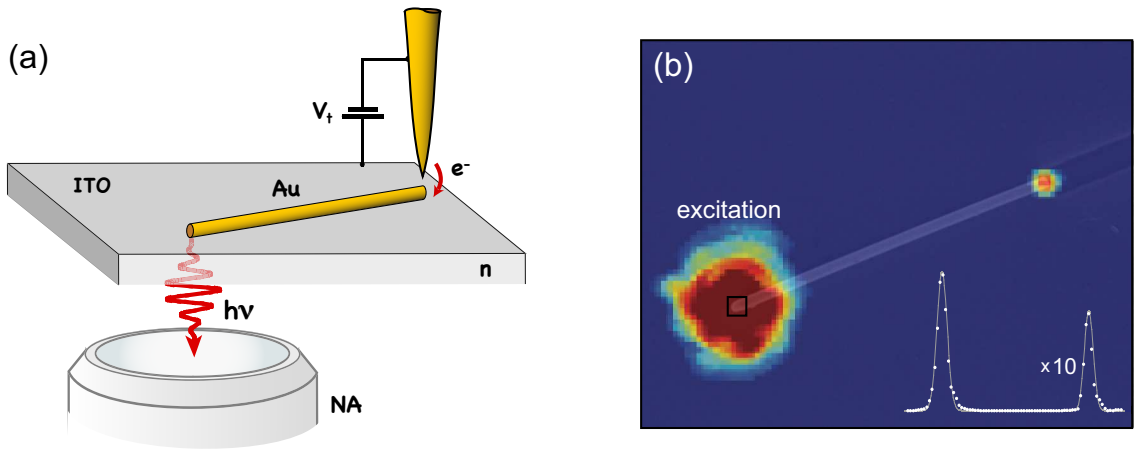

Figure 1: (a) Inelastic electron tunneling between a gold tip and a single-crystal gold nanorod gives rise to surface plasmon excitation. Locally excited surface plasmons propagate along the nanorod and scatter at the other end. Emitted photons are collected by an index-matched NA=1.4 objective and then analyzed. (b) Photon emission map superimposed to an SEM image. Inset: Intensity map along the nanowire showing diffraction-limited emission peaks from both ends.