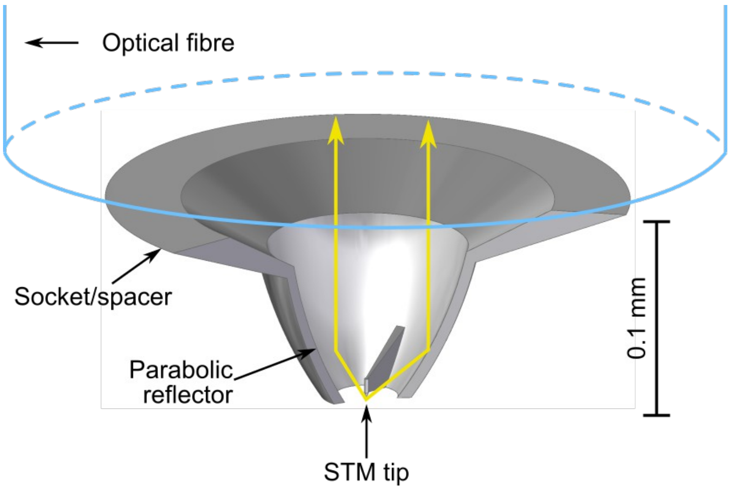
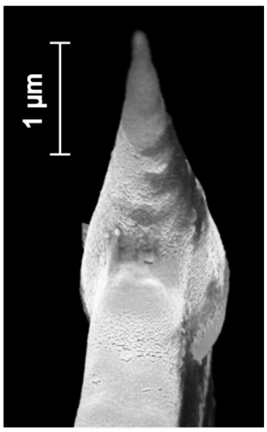
Karlsruher Institut für Technologie

Master Thesis

Optimizing light collection on the nanoscale

Understanding of light–matter interactions and electroluminescence in the nanocavity formed by a metallic nanostructure and a metal surface is essential for a number of applications in the field of nanophotonics. Electroluminescence experiments on the atomic or molecular scale, however, intrinsically suffer from very low intensities of the photon signal to be measured. Therefore, we developed a low-temperature scanning tunneling microscope (STM) that allows to collect light emitted from the nanometer-sized tunnel junction with highest efficiency. The key part is a microscopic parabolic mirror including the STM tip by using 3D direct laser writing (DLW). The collected light is then guided to a spectrometer or photon counting diode via an optical fiber.
While we have achieved record high photon count rates, we have not begun to optimize the design and the fabrication process of the parabolic mirror.
One part of this master thesis comprises CAD and fabrication of the parabolic mirror tips by using 3D DLW. In the other part, performance of mirror tips is systematically tested in-situ by measuring light emission from surface plasmons localized in the gap between the STM tip and the metal surface. The results will allow for the identification of relevant parameters for optimization of the next fabrication process.
The joint master thesis will be carried out at the Institute for Quantum Materials and Technologies (IQMT, CN) and the Institute of Applied Physics (APH, CS).





Left: Design of microscopic mirror. Right: SEM image of the tip apex

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