A Numerical Analysis of Apertureless Scanning Near-Field Optical Microscopy

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Over the last decades Scanning Near Field Microscopy (SNOM) has proven to be a useful technique for different research areas like nano optics, material science and Raman spectroscopy. The core of this technique is a sharp probe which allows for simultaneous measurement of topographic and optical information far beyond the diffraction limit.
For the modeling of the SNOM setups we have applied the multiple multipole program contained in OpenMaX, which is available under open source [1]. In order to overcome problems like overestimated near fields or resonances that arise when only considering finite tips, we have introduced a semi-infinite continuation of the tip, which incorporates the analytic solution of surface waves.
The type of excitation plays a major role in the efficient excitation of a strong near-field at the tip apex of an apertureless SNOM. We have considered different excitations, namely a focused radially polarized beam in top and bottom configuration and also an indirect excitation by a surface plasmon wave. The main properties of these excitation types will be discussed in the presentation.
Furthermore, we will discuss the influence of different tip geometries and tip materials on the achievable field enhancement. The results of these studies are intended to provide guidelines for an efficient experimental setup configuration.

[1] *"Openmax: Graphic platform for computational electromagnetics and computational optics."* C. Hafner, http://openmax.ethz.ch/, ETH Zürich (2013).