Near-field optical imaging and spectroscopy far beyond the diffraction limit: from molecular mono-layers to organic semiconductor films

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Since the first demonstration of scanning near-field optical microscopy more than twenty years ago one of its major goals has always been to recognize and identify chemical structures using optical spectroscopy in combination with the high spatial resolution of scanning tip microscopy. However, many interesting samples are non-transparent and hence make it difficult if not impossible to access the nanometer gap between the probing tip and the sample surface with a high optical resolution microscope. Hence, quantitative spectroscopic measurements with an optical resolution matching the molecular morphology of organic films has been plagued either by a lack of resolution, contrast or sensitivity. To address this challenging issue we have developed a novel near-field optical microscope with a parabolic mirror for tip illumination and signal collection which are performed from the top of the sample under perfect diffraction and polarization conditions. Hence no restrictions apply with respect to the conductivity or transparency of the samples. We will provide illustrative examples to demonstrate the performance with respect to spectroscopic imaging (tip-enhanced photoluminescence, TEPL and Tip-enhanced Raman scattering, TERS), sensitivity and resolution.