High Spatial Resolution Raman Microspectroscopy – Applications in Microbiology

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The intensity increase of Raman scattered light is crucial for detecting signal variations in sub-micron investigations. In order to meet these requirements, tip-enhanced Raman scattering (TERS) is evaluated as a new near-field based spectroscopic technique for local analysis of (biogenic) nanoparticles.

However, another promising and completely new approach for characterization on the nanometer scale by Raman spectroscopy is based on a strong signal enhancement by dielectric particles attributed to the appearance of a photonic nanojet on the shadow side of such a laser-irradiated particle. The talk introduces the method and describes how the strong Raman signal enhancement by dielectric spheres can be exploited for increasing the sensitivity and spatial resolution in Raman spectroscopic investigations. With an SiO_2-sphere attached to the apex of a scanning probe tip line scans are performed across 150 nm wide SiGe line structure (non transparent) and 80 nm large protein fibril (transparent samples), the obtained results show a significantly improved spatial resolution compared to scans performed with retracted tip. Due to the non-evanescent character of photonic nanojets the axial dimension or penetration dept is larger than for pure near-field techniques such as tip-enhanced Raman spectroscopy. Therefore, the Photonic-Nanojet-enhanced-Raman-Scattering (PNERS) enables also high resolution spectroscopic investigations even in deeper parts of the sample.