Correlation of electron microscopy and near-field Raman spectroscopy

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The correlation of optical microscopy and Raman spectroscopy is nowadays a widely used method for investigating cells, spores and other samples in the µm range [1]. The resolution of optical techniques is however limited by diffraction, thus preventing investigations of structures smaller than l/2. For correlative characterization of nanostructures the applied microscopic techniques must provide a resolution in the nm-range and a significantly improved sensitivity simultaneously. Recent electron microscopic techniques like high-resolution transmission electron microscopy (HR-TEM) offer a spatial resolution in the sub-nm range, thus enabling even the visualization of single atoms in crystalline samples [2]. The application of surface-enhanced Raman scattering (SERS) increases the Raman scattering cross section by several orders of magnitude, providing detection limits down to single molecule level [3]. This high sensitivity is exploited in tip-enhanced Raman scattering (TERS), where a metalized AFM tip is used to gain topographic and spectroscopic information from nanoscale surface features. The combination of electron microscopy [4] and tip-enhanced Raman spectroscopy [5, 6] would provide not only morphological but also spectral information on a nano-scale thus enabling a reliable identification of unknown single biological particles.

References

[1] A. Hermelink, A. Brauer, P. Lasch and D. Naumann, *Analyst* 134, 1149-1153 (2009).
[2] Y. Jie et al., *J. Appl. Phys.* 109, 033107 (2011).
[3] M. Laue, *Methods in Cell Biology* 96, 1-20 (2010).
[4] D. Cialla, T. Deckert-Gaudig, et al., *J. Raman Spectroscopy* 40, 240-243 (2009).
[5] P. Hermann, A. Hermelink, V. Lausch, et al., *Analyst* 136, 1148-1152 (2011).