Imaging Tip-enhanced Raman Spectroscopy (iTERS) – a new efficient method for fast TERS imaging

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Tip-enhanced Raman Spectroscopy (TERS) provides chemical information with subnanometer resolution. However, from a practical point of view, it is difficult to get a detailed mapping of molecules in the nanometer range due to the intrinsic and unavoidable thermal drift of the system and the generally long acquisition times of CCD based Raman systems.
Here we developed a new system that records a bandwidth selected spectral response synchronously to the AFM imaging in order to create rapid and precise tip-enhanced Raman maps (Fig. 1). Specifically, we demonstrate the potential to acquire tip-enhanced Raman signals (by integration of the signal of a large spectral range using a balanced photoreceiver) for one pixel within an acquisition time of 4 ms.
Figure 2 shows domains of Raman active molecules (DNA origami) what can be visualized during the AFM measurement. It is our belief that this method enables an easier correlation of AFM and TERS information and consequently locates molecules on various substrates and effectively overcomes the thermal drift problem. This way AFM-based TERS set up, can reach resolutions similar to STM considering chemical effects.[1]

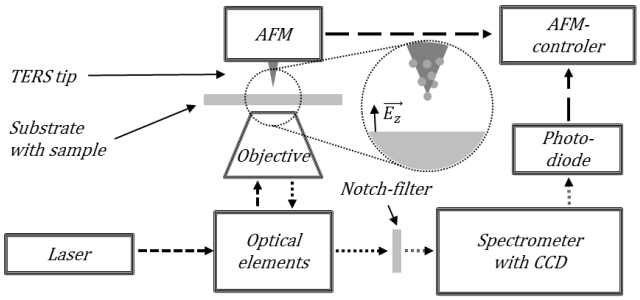

Fig. 1: schematic from the experimental iTERS setup

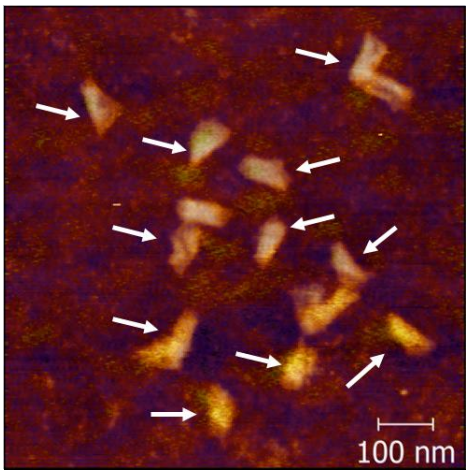

Fig. 2: iTERS image (height + diode signal) from Origamis on glass. Yellow areas Origamis with active tip. Signal loss was at half-finished image.

[1] F. Latorre, S. Kupfer, T. Bocklitz, D. Kinzel, S. Trautmann, S. Gräfe, and V. Deckert, "Spatial resolution of tip-enhanced Raman spectroscopy – DFT assessment of the chemical effect," Nanoscale, vol. 8, no. 19, pp. 10229–10239, 2016.