Differences between SERS and TERS

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Metal nanoparticles under laser irradiation generate surface plasmons (SP), which are an important tool in surface-enhanced Raman spectroscopy (SERS), as well as in tip-enhanced Raman spectroscopy (TERS). In SERS many metal nanoparticles are used to enhance the Raman signal is an established technique, while TERS uses just a single nanoparticle to enhance the Raman signal. TERS is technically different from SERS as a single nanoparticle is used as an enhancing unit (metal coated AFM tip). Thus, the enhancing area is restricted to few nanometers and a spatial resolution of few nanometers and even sub nanometer [1, 2] has been experimentally demonstrated.

Here, we present a systematic study to compare SERS and TERS spectra of self assembled monolayers (SAM) of thiophenol, to investigate the respective spectroscopic differences. The TERS spectra, when measured at different positions on the SAM, shows large peak position fluctuations of about 6-9 cm^{-1} compared to < 2 cm^{-1} for SERS measured on gold nanoparticles or silver island substrates. At the same time the full-width-half-maximum (FWHM) of the SERS spectra is reproducibly larger compared to TERS and increases with number of nanoparticles and molecules in the laser focus [3].

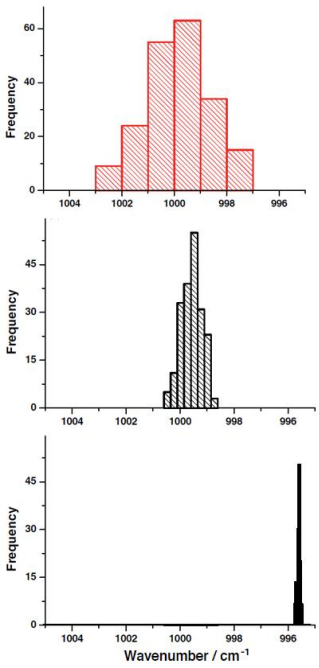

Fig 1: Peak position variation for ring breathing mode of thiophenol measured in TERS (top), SERS on Au (middle) and SERS on Ag (bottom).

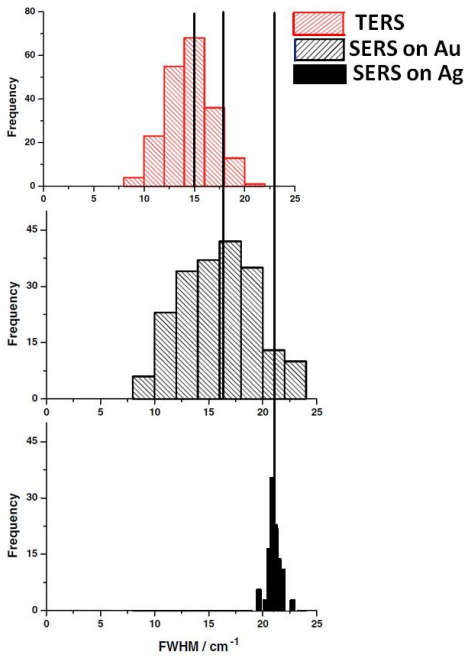

Fig 2: FWHM variation for same thiophenol band showing larger FWHM for SERS.

*[1] R. Zhang, et al., Nature. 2013, **498**, 82–86.*
[2] T. Deckert-Gaudig, E. Kämmer, and V. Deckert, J. Biophoton. 2012, 5, 215–219.
[3] P. Singh, et. al. , PCCP, 17, 2991, 2015.