Infrared correlation nanoscopy with unprecedented spectral coverage

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Nanoscale resolved imaging and spectroscopy using scattering-type Scanning Near-field Optical Microscopy (s-SNOM) or tapping AFM-IR (local detection of photothermal expansion) bypasses the diffraction limit of light to achieve a wavelength-independent spatial resolution of < 20 nm in the infrared (IR) frequency range [1,2]. A wide range of analytical capabilities have been demonstrated, e.g. nanoscale chemical mapping and material identification [3], conductivity profiling [4,5], determination of secondary structure of individual proteins [6] and vector field mapping [7], making them a trusted tool for surface analysis in many branches of sciences and technology. Applications are often limited by a lack of suitable light sources, preventing studies of low energy phonons, polaritons, and molecular vibrations. Here we demonstrate s-SNOM and tapping AFM-IR imaging and spectroscopy based on a fully integrated and automated commercial OPO laser source, covering the spectral range 1.4 – 18 μm (ca. 7140 – 550 cm-1) with narrow linewidth < 4 cm-1 in the entire tuning range. Sweeping the laser frequency enables nano-spectroscopy with unprecedented spectral coverage, enabling studies of fundamental molecular resonances and quantum states in the long wavelength IR spectral range, which until now was not possible.

References

[1] F. Keilmann, R. Hillenbrand. Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences, 362, 787–805, (2004).
[2] J. Jahng, et al.,. PNAS, 116, 26359-26366, (2019).
[3] F. Huth at al., Nano Letters, 12, 8, 3973-3978 (2012).
[4] J. Stiegler et al., Nano Letters, 10, 4, 1387-1392 (2010).
[5] N. A. Aghamiri et al., Optics Express, 27, 17, 24231-24242, (2019).
[6] I. Amenabar et al., Nature Communications, 4, 2890 (2013).
[7] P. Alonso-González, Nature Communications, 3, 684 (2012).