Committing SINS at the ALS: Synchrotron Infrared Nano-spectroscopy and Imaging

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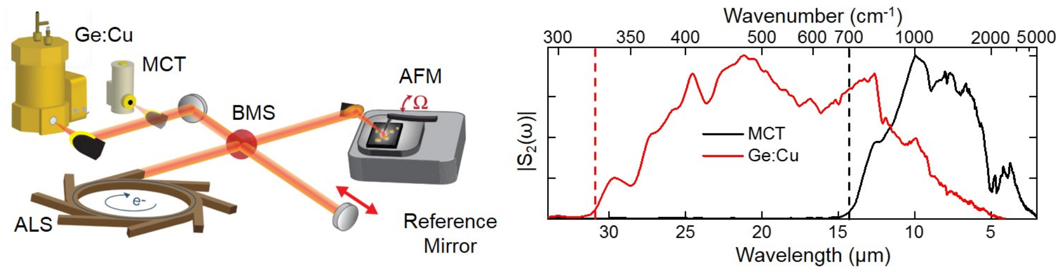
Infrared (IR) spectroscopy is a label-free, minimally invasive, analytical technique that provides chemical identification of a wide variety of molecules and materials based on the absorption of intrinsic vibrational and phonon modes. Traditionally, the spatial resolution of IR *micro*-spectroscopic techniques has been limited by the long wavelengths of IR light to about 2-10 μm in the mid-IR region. Here, we describe synchrotron infrared *nano*-spectroscopy (SINS), which improves the spatial resolution of IR spectroscopy to $<$ 25 nm by combining the spectrally bright and broadband features of synchrotron IR radiation with the spatial resolution and sensitivity of scattering-type, scanning nearfield optical microscopy (s-SNOM) [1]. This powerful combination empowers a qualitatively new form of nano-chemometric analysis with the investigation of nanoscale, mesoscale, and surface phenomena that were previously difficult to study with IR techniques. The Advanced Light Source (ALS) at Lawrence Berkeley National Laboratory operates two infrared beamlines with SINS instruments that are available to general users who have applied the technique to a variety of soft and hard matter systems, including proteins, organic semi-conductors, bio-minerals, 2D materials, and phase-change materials. Here, we highlight our efforts to extend SINS into the far-IR region ($<$ 500 cm^{-1}) and demonstrate several measurements that take advantage of the nanometer spatial resolution of SINS.



(A) Schematic of SINS experimental configuration: beamsplitter (BMS), atomic force microscope (AFM), mercury cadmium telluride (MCT), copper-doped germanium (Ge:Cu). (B) SINS signal on gold with two different detectors, illustrating the broad spectral range.

References

[1] Bechtel, H A.; Muller, E. A.; Olmon, R. L.; Martin, M. C.; Raschke, M. B. *PNAS* **2014**, *111*, 7191–7196.