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Synchrotron Infrared Nano-Spectroscopy ERIC MULLER, BENJAMIN POLLARD, Univ of Colorado - Boulder, HANS BECHTEL, MICHAEL MARTIN, Lawrence Berkeley National Laboratories, MARKUS RASCHKE, Univ of Colorado - Boulder — Heterogeneity underlies many fundamental physical processes and biological functions, and characterizing or ultimately controlling these requires spectroscopic imaging with simultaneous nanometer spatial resolution and sensitivity to chemical structure and composition. In ultrahigh resolution spectromicroscopies, however, spectroscopic sensitivity and spatial resolution often oppose one another. We overcome this limitation with scattering scanning near-field optical microscopy using synchrotron infrared radiation. In this method, the tip of an atomic force microscope acts as an optical antenna, localizing broadband synchrotron infrared radiation with high irradiance and low noise, enabling tip-limited imaging at $\leq$40 nm resolution. Optical heterodyne amplified, Fourier-transform detection enables rapid spectral acquisition, spanning 700-5000cm^{-1}, with zeptomole (10^{-21}) sensitivity. Synchrotron infrared nano-spectroscopy (SINS) is broadly applicable, which we demonstrate through investigations of surface phonon polaritons, biominerals and proteins. Finally, we show preliminary results incorporating advanced optical-antenna designs, with the goal of single molecule infrared spectroscopy.

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