Infrared nano-scopy of complex materials

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Applications of infrared (IR) spectro-microscopy in science and technology extend to such diverse areas as physics, chemistry, life sciences and biology, materials science and engineering, forensics and national security. The underlying reason behind such an unprecedented scope is that many fundamental properties of matter have characteristic energy scales falling in the infrared range. Conventional and synchrotron-based IR microscopy enables characterization of these properties in inhomogeneous substances with the diffraction-limited spatial resolution (10-50 μm). The impact of IR microscopy both in life and materials/physical sciences strongly motivates the development of experimental approaches suitable for an infrared probe of matter at the nanoscale. Recently, significant progress in infrared *nano-scopy* has been achieved by several research groups through an innovative combination of atomic force microscopy and IR lasers. Novel scanning near field IR instrumentation facilitates both spectroscopy and imaging with the spatial resolution down to 10 nano-meters or better. I will overview recent applications of this technique for the studies of the electronic phase separation in transition metal oxides and characterization of semiconductor devices.