Ultrahigh Spatial Resolution Infrared Spectroscopic Imaging of the Phase Behavior of Block-Copolymer Nanostructures

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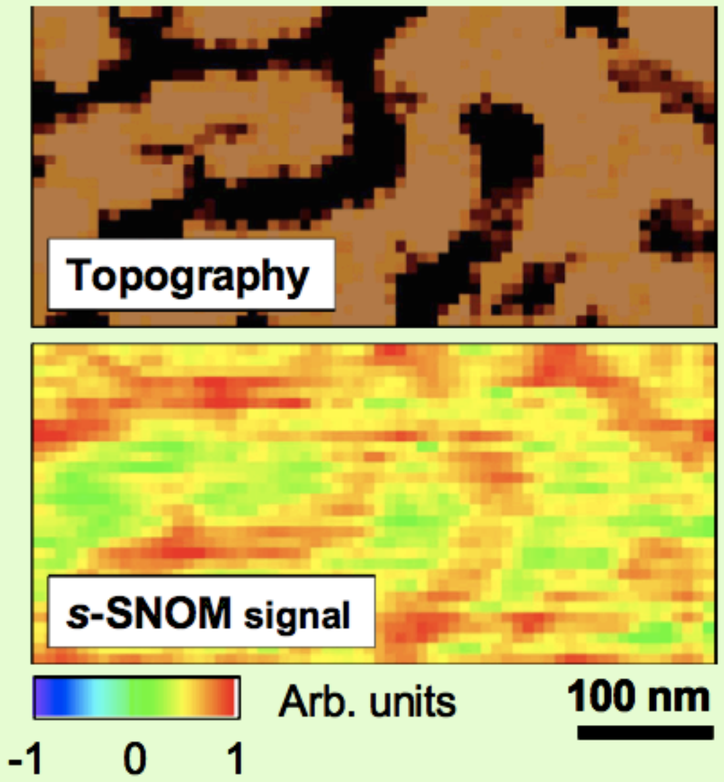
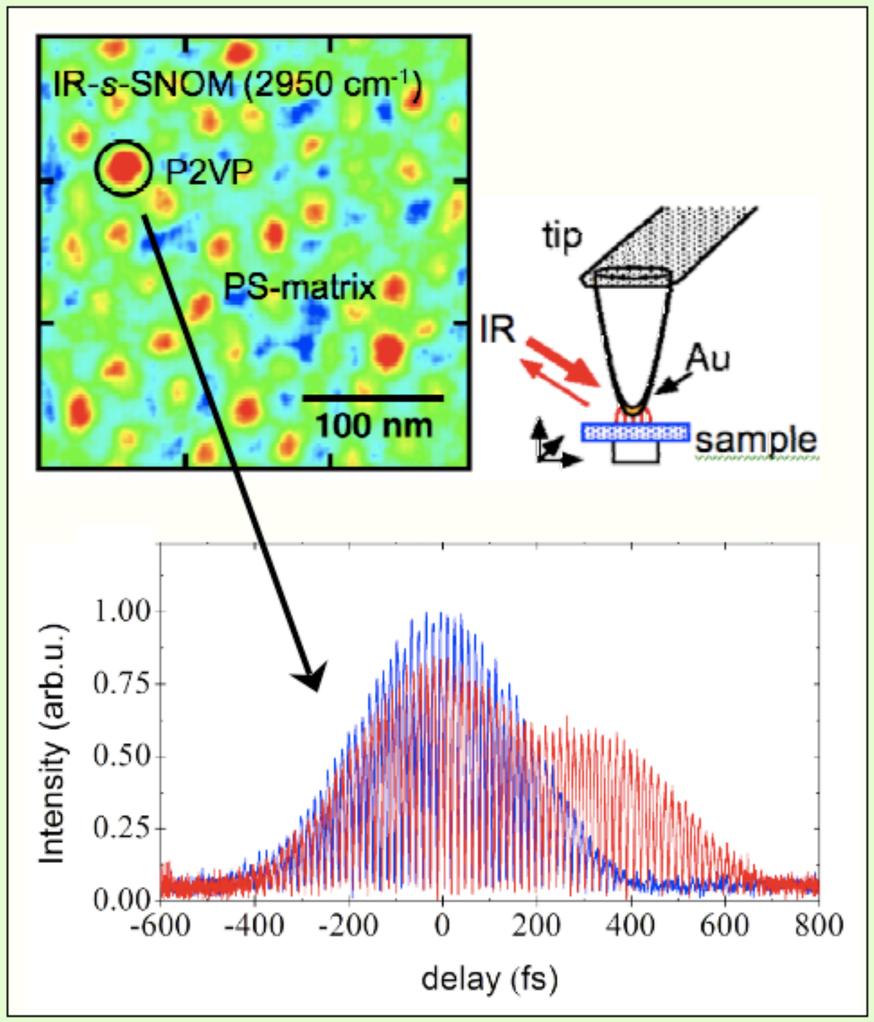
Project goal: Development of scattering-scanning near-field optical microscopy (s-SNOM) for infrared vibrational spectroscopic imaging in the 3 - 12 μm spectral range with spatial resolution as high as several 10's nanometers to access characersitic length scales in block-copolymers or molecular nanocomposites.



Femtosecond sSNOM: use of broad-band mid-IR femtosecond laser pulses together with interferometric homodyne detection allowed first vibrational free-induction decay studies. The signal of a P2VP domain of only several hundred vibrational oscillators (red) with autocorrelation response of the IR pump pulse for comparison (blue).



Near-field imaging: Topography (top) and s-SNOM signal (bottom) of PS-b-PMMA block copolymer with CO_2 laser excitation at 10.6 μm. Polystyrene matrix regions (darker regions in topography) produce higher optical signal that the PMMA regions due to different vibrational mode characteristics.