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nano-FTIR Correlation Nanoscopy for Organic and Inorganic Material Analysis

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Scattering-type Scanning Near-field Optical Microscopy (s-SNOM) is a scanning probe approach to optical microscopy and spectroscopy, bypassing the ubiquitous diffraction limit of light to achieve a spatial resolution below 20 nanometers. s-SNOM employs the strong confinement of light at the apex of a sharp metallic atomic force microscopy (AFM) tip to create a nanoscale optical hot-spot. Analyzing the scattered light from the tip enables the extraction of the optical properties of the sample directly below the tip and yields nanoscale resolved optical images simultaneous to topography of the sample [1]. In addition, the technology has been advanced to enable Fourier-Transform Infrared Spectroscopy on the nanoscale (nano-FTIR) [2] utilizing broadband radiation from the visible spectral range to THz frequencies.

Recently, the combined analysis of organic and inorganic composite surfaces by correlating near-field optical data with information obtained by other nanomechanical and -electrical scanning probe microscopy (SPM)-based measurement methodologies has gained significant interest. For example, the material-characteristic nano-FTIR spectra of a phase-separated polystyrene/low-density polyethylene (PS/LDPE) polymer blend verifies sharp material interfaces by measuring across the interface across a ca. 1µm sized LDPE island. Near-field reflection and absorption imaging at an excitation wavelength of $1600 cm^{-1}$ of the ca. 50nm thin film allows to selectively highlight the distribution of PS in the blend and simultaneously map the mechanical properties like stiffness and adhesion of the different materials [3,4].

Further, we present results that correlate the near-field optical response of semiconducting samples like graphene (2D) or functional SRAM devices (3D) in different frequency ranges such as mid-IR & THz to Kelvin Probe Force Microscopy (KPFM) measurements. Thus, s-SNOM systems represent an ideal platform to gain novel insights into complex material systems by different near-field and AFM-based method.

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