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Infrared Phonon Fingerprinting of Nanocrystals through Broadband Near-Field Spectroscopy

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Near-field infrared spectroscopy has recently been demonstrated with the capability to resolve optical properties of sub-wavelength sample areas across a broad range of infrared frequencies. This method holds promise for the direct identification of sub-wavelength chemical composition in nanostructured and heterogeneous samples. We apply this technique to the study of phonon- resonant silicon carbide nanocrystals tens of nanometers in size using an apertureless scanning near-field optical microscope (SNOM) coupled to a pulsed broadband infrared laser source and FTIR spectrometer. We present measurements of nanocrystal near-field spectra in the range of 700-1200 cm−1 evaluated in comparison with the near-field spectra of bulk silicon carbide, calibrated using ellipsometry. A detailed analytic model of the probe-sample near-field interaction is applied for the identification of nanoscale resonant size effects. These techniques provide a powerful method for identifying and characterizing sub-wavelength nanocrystals in heterogeneous samples via near-field infrared "phonon fingerprinting."

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