Towards Ultimate Vibrational Spectroscopy with Single Molecule Sensitivity and Spatial Resolution

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We have studied to establish an ultimate vibrational spectroscopy relevant for *in situ* characterization of single molecules at solid/liquid interfaces. The blinking of SERS (Surface Enhanced Raman Scattering) arises from thermal diffusion of adsorbed molecule between junction and other ordinary sites as evidenced from correlation between Raman and elastic scattering spectra in addition to temperature dependence and local field evaluation. Exploiting SERS of underlaid silver films, Raman images with ca. 50 nm in spatial resolution were obtained simultaneously with topography using chemically etched optical fibers under an attenuated total reflection configuration.

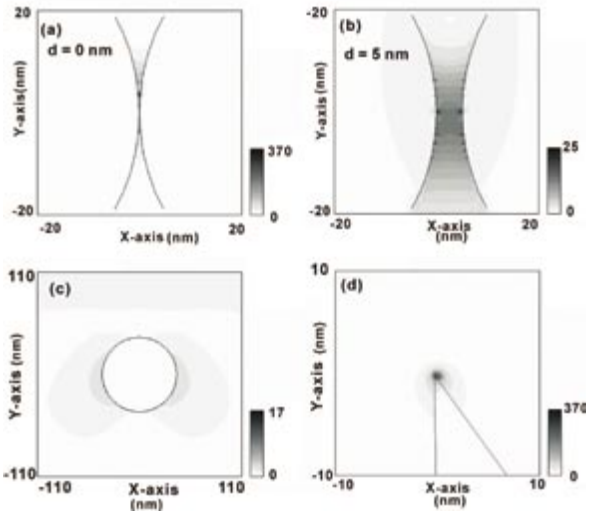

Figure electric field distribution (amplitude) for various Ag nanostructures: adjacent circular tubes (r = 40 nm) with the gap size of (a) 0 nm, (b) 5 nm, (c) isolated tube (r = 40 nm), and (d) triangular edge. Excited at the resonance wavelengths of 480 nm (a, b), 380 nm (c) and 430 nm (d). The enhancement > 330 yields single molecule sensitivity in Raman scattering.

Polytype Control of SiC Heteroepitaxial Films by Pulsed-Laser Deposition

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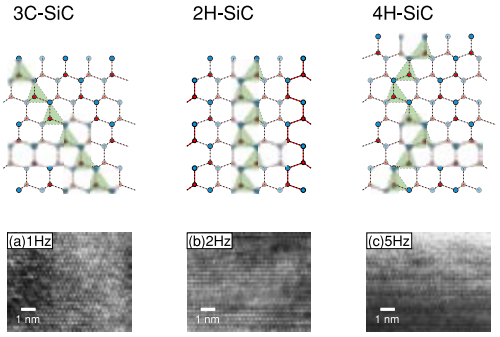
Polytype formation of SiC heteroepitaxial films is controlled using pulsed-laser deposition (PLD) technique. The 3C, 2H, and 4H-SiC films are fabricated on sapphire substrates at a low temperature of 1100°C. Transmission electron microscope images clearly show that each film consists of a single polytype. The SiC polytype of the films can be changed by varying only a single parameter: the laser pulse frequency. The result suggests that precise control of the growth conditions, which is essential for polytypic materials, is possible using the PLD method. Our technique allows new application of SiC electronics such as high-temperature, high-power, and high-speed heterostructure devices.



Crystal structure of 3C, 2H, and 4H-SiC polytypes (upper) and high resolution images of SiC films fabricated at different laser pulse frequencies (lower)