A WIDE-FIELD IMAGING APPROACH FOR SIMULTANEOUS SUPER-RESOLUTION SURFACE-ENHANCED RAMAN SCATTERING IMAGING AND SPECTROSCOPY

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The ability to simultaneously obtain high spatial resolution images and chemical specific information is of interest in a variety of biological and physical processes. Surface-enhanced Raman scattering (SERS) is particularly suited for this purpose due to its ability to enhance signal from Raman vibrational modes by probing molecules near the surface of plasmonic metal nanostructures. The spatial resolution in SERS imaging is limited by the diffraction limit of light, limiting the resolution to hundreds of nanometers. However, Raman reporter molecules adsorbed to single nanoparticles experience temporal intensity fluctuations that enable the SERS signal to be fit with localization algorithms, such as stochastic optical reconstruction microscopy (STORM). STORM fittings can be applied to generate images with sub-diffraction limited localization of the emitting centers from the nanoparticles. In this work, we demonstrate a wide-field spectrally resolved SERS imaging approach where a transmission diffraction grating placed before the imaging array detector captures the image and first-order diffraction on the same detector. The first-order diffraction corresponds to the SERS spectrum and can be directly correlated to the location and features of a nanoparticle. STORM fitting both the spatial and spectral response results in improved localization in the spatial response and improved peak identification compared to the measured spectra in the spectral response. We show that spatially correlated Raman spectra from multiple nanoparticles in a wide-field of view are readily obtained on a 10-100 ms time scale, which enables spatially resolved monitoring of chemical processes.