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RAMAN MICROSCOPY AND IMAGING. APPLICATIONS TO MONOLAYERS AND SINGLE MOLECULE DETECTION

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Surface enhanced resonance Raman scattering (SERRS) combines the multiplicative enhancements of SERS and resonance Raman scattering (RRS). The latter two resonances make it possible to obtain total enhancement factors on the order of ca. 10^{10} or greater[1]. This effect is the result of laser excitation being in resonance with the absorption bands of an adsorbate near an appropriate enhancing metal nanostructure. The Langmuir-Blodgett (LB) technique has recently been used to obtain spatially resolved surface-enhanced resonance Raman scattering spectra of single dye molecules dispersed in the matrix of a fatty acid[2,3]. The properties of single molecule detection (SMD) are investigated here using the spatial resolution of micro-Raman including mapping and global imaging[4]. New substrates for SMD are being fabricated, and, in particular, the results obtained by mixing Ag and Au to form island films suitable for LB work to achieve single molecule

detection are discussed. The SERRS spectra of a series of perylene tetracarboxylic diimide (PTCD) derivatives on Ag, Au and mixed Ag/Au island films obtained using Langmuir-Blodgett monolayers containing, in average, one molecule per micron square of surface are reported. PTCD molecules are imbedded in an optically inert fatty acid matrix, and spatially resolved using SERRS. The new substrates are characterized by UV-visible absorption spectroscopy, X-ray photoelectron spectroscopy, and atomic force microscopy (AFM). Surface-enhanced fluorescence (SEF) spectra and Raman imaging, including line mapping and global images recorded at different temperatures were also obtained. Spectral properties such as bandwidth and relative intensities observed for single molecule SERRS in the LB monolayer are discussed.

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