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Fabrication and SERS Characterization of Plasmonically Coupled Nanoparticles With Nanometer Separation JESSE THEISS, PRATHAMESH PAVASKAR, PIERRE M. ECHTERNACH, STEPHEN B. CRONIN — Electron beam lithography, in conjunction with an angle evaporation technique is used to produce arrays of nanoparticles separated by 1-2nm. High resolution transmission electron microscopy (HRTEM) enables us to image these nanometer-sized gaps when fabricated on thin silicon nitride membranes. These nearly touching nanoparticles produce exceptionally high electric field intensities when irradiated with light near the plasmon frequency, yielding surface-enhanced Raman spectroscopy (SERS) signals. We deposit a para-aminothiophenol (p-ATP) dye molecule on the nanoparticle structures and spatially map the Raman intensity using confocal micro-Raman spectroscopy to quantitatively study the SERS enhancement. We find a significant increase in Raman intensity with laser polarization oriented along the axis of the nanoparticle pairs and little enhancement for the perpendicular polarization. Finite difference time domain (FDTD) simulations based on the HRTEM images predict an enhancement in the electric field intensity of 44,000 at the center of the nanoparticle gap and a corresponding electromagnetic SERS enhancement factor on the order of 10^9.

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