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Designer Plasmonics Nanostructures Approaching Single Molecule Raman Scattering REUVEN GORDON, QIAO MIN, GUSTAVO F.S. ANDRADE, ALEXANDRE G. BROLO, University of Victoria — Since the early reports of single molecule Raman scattering detection using randomly roughened metal substrates [Phys. Rev. Lett. 78, 1667 - 1670 (1997), Science 21, 275(5303), 1102 - 1106 (1997)], there has been considerable interest in achieving single molecule Raman spectroscopy from fabricated nanostructures that are not random. Such designer plasmonic nanostructures have the advantages of improved control over the near-field enhancement magnitude, deterministic placement of the local-field hotspots, optimized collection efficiency and greater reproducibility. Previously, we have created a metal nanostructures with measured 20 molecule Raman signal limit of detection [J. Phys. Chem. C 112 (39), 15098-15101, (2008)]. To achieve the desired near-field electric field enhancements, those nanostructures contained familiar elements to the plasmonic community: concentric focusing rings and subwavelength focusing tapers. Here, we will describe improved designs that have enabled us to improve those results by a factor of 6. We will also show polarization dependent studies that clearly demonstrate the plasmonic nature of the subwavelength focusing structures, including experimental polarization-resolved Raman spectroscopy maps. We are beginning statistical analysis experiments to determine if single molecule Raman is present in these nanostructures.

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