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Surfaced Enhanced Raman Spectroscopy in Nanojunctions with Anomalous Polarization Dependence JOSEPH B. HERZOG, MARK W. KNIGHT, YAJING LI, KENNY EVANS, NAOMI J. HALAS, DOUGLAS NATELSON, Rice University — Several papers have been published on surfaced enhanced Raman spectroscopy (SERS) in nanojunctions, and polarization studies have shown that the strongest SERS enhancement is generated when the incident light is polarized so that the electric field is directed across the interelectrode nanogap. This polarization dependence is certainly true for mesoscale structures such as dimers, but this works show that this is not always the case. Here we create nanogaps both by electromigration and a novel "self-aligned" process, which can be scaled for mass production. Polarization dependent SERS measurements were performed on these junctions and have determined that transverse polarization of incident light generates the strongest SERS enhancement. Cathodoluminescent experiments as well as finite element method calculations have confirmed these findings and together with the experimental results have determined that the enhancements are due to strong localized hybrid modes in the gap which couple to a resonant transverse plasmon mode. This new finding has increased device sensitivity by an order of magnitude and opens the possibility for improved plasmonically-active optoelectronic devices and other nanophotonic applications.

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