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Theory of surface enhanced Raman scattering from a molecule adsorbed on a chain-like cluster of metallic nanoparticles and nanoshells
JEANNE BONNER, KARAMJEET ARYA, San Jose State University, San Jose —
The Raman cross-section from a molecule is believed to enhance by more than 10 orders of magnitude when it is adsorbed on a cluster of silver nanoparticles. These large enhancements are attributed to the resonant excitation of the surface plasmon modes of the cluster those have very large localized electric field near its surface. The resonant position and the electric field of these modes are very sensitive to the structure of metal particles and the size and shape of the cluster. Using multiple scattering in the wave-vector space between the individual particles in the cluster we have calculated the resonant position of these modes and their enhanced electric field for clusters of different shape formed from two, three, and four nanospheres and nanoshells. We find the maximum enhancement in the cross-section can reach up to 10 orders of magnitude for silver particle clusters. We also find important new results for the chain like clusters of three or more particles where there is a dramatic increase in the enhancement due to very sharp resonant features of the modes. These features may be helpful in identifying the cluster shape and size in the surface enhanced Raman scattering experiments.

Karamjeet Arya
San Jose State University, San Jose

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