



Single molecule detection using Raman spectroscopy with Ag nanocrystal antennas

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Professor Louis Brus
Samuel Latham Mitchill Professor of Chemistry
Columbia University

30 nm Ag particles can act as almost ideal "nano-antennas" for visible light. Of particular interest, two touching 30nm Ag nanocrystals exhibit a "hot spot" in the local field enhancement at the junction. If a molecule is chemisorbed in the junction and also electronically resonant with the laser, this enhancement is sufficient to enable single molecule Raman spectroscopy. The unrelaxed "hot electron" coherent polarization in the metal can also photo-oxidize adsorbed citrate molecules, leading to a cathodic shift in the Ag nanocrystal redox potential. This shift is directly observable in a photo-electrochemical apparatus, for nanocrystals adsorbed on a transparent electrode. Such photo-oxidation of citrate can lead to photo-catalyzed growth of the Ag particle if there is Ag⁺ in solution. The irradiation wavelength controls the shape of the final particle. The laser-induced coherent ac polarization also creates a strong attractive potential squeezing the junction.

Professor Lou Brus has an undergraduate degree from Rice University and a PhD from Columbia University, both in Chemical Physics. His 1969 PhD thesis concerned gas phase photodissociation with the late Prof. Richard Bersohn. As a Lieutenant in the U. S. Navy, he worked in the solid state and chemistry divisions of the Naval Research Laboratory (1969-1973). In 1973 he joined the chemistry and materials research area of Bell Laboratories in Murray Hill, NJ. In Bell Labs he worked at first on the internal dynamics of small molecules in rare gas solids (1973-1980), and pump-probe transient Raman studies of short lived chemical intermediates (1980-1987). After 1983 he increasingly focused on nanocrystals made by chemical synthesis, and novel materials incorporating nanocrystals. He joined the Columbia chemistry faculty in 1996. His present research interests include graphene and carbon nanotubes, the excited states of metallic nanocrystals and local electromagnetic field enhancement, synthesis of semiconductor and oxide nanocrystals, electric force microscopy, and optical characterization (Rayleigh, Raman, Luminescence) of single nano-objects. He is a member of the US National Academy of Sciences, and was Chairman of the Board of Trustees of the Gordon Research Conferences in 1998. He has won the following awards: the 2001 APS Irving Langmuir Prize in Chemical Physics, the 2004 ACS Chemistry of Materials Prize, and the 2005 R. W. Wood Prize of the Optical Society of America.

Light refreshments will be served prior to seminar

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