A THERMODYNAMIC APPROACH FOR INTERPRETATION OF ABSORPTION SPECTRA OF GOLD NANOROD COLLOIDAL SOLUTION

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Abstract

The excitation of surface plasmons at metallic nanoparticles (MNPs) by light, denoted as localized surface plasmon resonance (LSPR), is phenomenon which attracts a great deal of attention in both theoretical and experimental research. Moreover, during past decade a number of different MNPs shapes was synthesized and those method refined to a point, where high-yield samples of non-spherical metallic MNPs can be obtained. The unique electro-optical properties of such MNPs induced number of applications; spanning from fundamental studies of colloidal systems to application in biological systems as a biocompatible and addressable carrier. For those applications a good description of MNPs system is needed. This is, however, still an issue; namely concentration and amount of unwanted shapes in system. We present a thermodynamic approach to interpret MNP solutions absorption spectra. As the MNPs have tunable plasmonic properties, dependent on volume, morphology, and solvation in solution, one can derive parameters of such system by the means of optical absorption spectroscopy: in case of colloidal solution, where particle parameters are normally distributed, one can analyze some of solution parameters by formulating a system of minimized number of LSPR modes, whose are subject to spectral broadening by normally distributed particle dimensions, fitted in the absorption spectra. For this purpose, we use seeded grown gold nanorods samples, as a prototype of non-spherical MNP systems, containing various amounts of impurities and with different particle distributions. Samples are characterized both by standard means and by proposed interpretation to discuss possible advantages and shortcomings of this approach.

Keywords: localised surface plasmon resonance, metallic nanoparticles, gold nanorods

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