PLASMONICS: FUNDAMENTALS AND APPLICATIONS

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Interest in the optical response of metal nanoparticles (NPs) arises from the pronounced morphology-dependent physical properties of these systems. Metal NPs strongly couple with light through excitation of surface plasmon resonances, which are collective oscillations of the electrons near the interface between a conductor (NPs) and an insulator (ambient). This strong coupling leads to novel phenomena at the nanometer scale, including localization and consequent enhancement of the electromagnetic field that can be manipulated for energy transport and storage, significant increase in the sensitivity of sensors and spectroscopies, enhanced optical forces for controlling the growth of nanoparticles, increased light absorption for improving photovoltaic devices, photo-thermal destruction of cancer cells and pathogenic bacteria, and many other technological applications.

In this talk, I will discuss some of our key contributions to localized surface plasmon resonances of metal nanostructures making emphasis in basic concepts and applications. I will also discuss our recent contributions of morphology and optical properties of gold and silver nanoparticles that are obtained using a strategic combination of theoretical and numerical techniques [1,2,3]. This combination approach show how the optical properties of gold nanoparticles respond to changes in the size, shape, or temperature, obtained by sampling the optical spectrum over large configuration space, in accordance with the nanoscale phase diagram. Shape-dependent phase diagrams are developed, and the structural and color properties of isotropic and anisotropic gold and silver nanoparticles are predicted for different sizes and colloidal concentrations. Calculated maps reveal an intimate relationship between size, morphology, temperature, environment, and optical properties. Color variations of samples with different refraction indices are also examined. As we will show, the theoretical results discussed here are in excellent agreement with experimental observations.

Keywords: Plasmonics; Localized Surface Plasmons Resonances; Gold Nanoparticles; Gold Nanorods; Silver Nanoparticles

References

[1] A.L. Gonzalez, C. Noguez, A. S. Barnard, J. Phys. Chem. C **116**, 2012, 14170—14175.
[2] A.L. Gonzalez, C. Noguez, A. S. Barnard, J. Mater. Chem. C **1**, 2013, 3150--3157.
[3] A.L. Gonzalez, J. Beranek, C. Noguez, A. S. Barnard, in preparation, 2013.