MODELS TO DESCRIBE SECOND HARMONIC LIGHT SCATTERING FROM COLLOIDAL PARTICLES

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Different models have been adopted to describe light scattering from particles. Mie theory provides an analytical solution of Maxwell's equations, but only works for spherical particles. Alternatively, while the Rayleigh-Gans-Debeye (RGD) model is capable of treating non-spherical particles, it is restricted to systems (i.e., particle and external medium) that exhibit refractive index matching. Finally, in the limit of a non-spherical particle shape, for systems lacking refractive index matching, numerical methods, such as the discrete dipole approximation (DDA), become the only way to describe the scattered field. Over the past 10 years, these different models, originally developed to describe linear scattering, have been extended to describe nonlinear second harmonic scattering (SHS) [1]. Our group has successfully employed nonlinear RGD [2] and Mie [3] theories to describe SHS from nano- and micron sized polymer beads. However, for metallic nanoparticles in water, the RGD model is not applicable due to a refractive index mismatch, whereas Mie theory is inadequate because of the non-perfect spherical particle shape [4]. Subsequently, we are currently exploring alternative models, such as those based upon the DDA, to describe these challenging systems.

[1] S. Roke, G. Gonella, Nonlinear light scattering and spectroscopy of particles and droplets in liquids, Annu. Rev. Phys. Chem., 63 (2012) 353.
[2] S.-H. Jen, H.-L. Dai, G. Gonella, The effect of particle size in second harmonic generation from the surface of spherical colloidal particles. II: the nonlinear Rayleigh-Gans-Debye model, J. Phys. Chem. C, 114 (2010) 4302-4308.
[3] G. Gonella, H.-L. Dai, Determination of adsorption geometry on spherical particles from nonlinear Mie theory analysis of surface second harmonic generation, Phys. Rev. B, 84 (2011) 121402/121401-121405.
[4] G. Gonella, W. Gan, B. Xu, H.-L. Dai, The Effect of Composition, Morphology, and Susceptibility on Nonlinear Light Scattering from Metallic and Dielectric Nanoparticles, J. Phys. Chem. Lett., 3 (2012) 2877-2881.

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