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First Hyperpolarizability of Carbonaceous Nanoparticles

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Extended Abstract

Second order non-linear optical materials have applications in telecommunications, optical switching, and signal processing. The first hyperpolarizability (β) data at the molecular level is needed to quantify their potential in applications. In this work, the first hyperpolarizability was measured for a new class of materials known as carbon nanoparticles via second harmonic light scattering technique (SHLS) in solution. These nanoparticles were first reported by Xu et al. [1] in 2004 and have subsequently been prepared in the laboratory by various synthetic methods. We have prepared two different sizes (26 and 35 nm) by hydrothermal method using glucose as a precursor. Since the carbon nanoparticles contain a significant amount of oxygen, nitrogen, and hydrogen along with carbon, we call them carbonaceous nanoparticles (CNPs). The second order nonlinearity of CNPs have not been reported and our experiments show that CNPs scatter second harmonic (SH) light, and their first hyperpolarizability (β) lies in the order of 10^{-27} esu per nanoparticle which is 10^2 times higher than that of para-nitroaniline but lower by a factor of 10^3 than that of gold nanoparticles. The monochromator scan of second harmonic light scattered from CNPs in aqueous solution shows a broad peak arising from multi photon fluorescence (MPF) along with a sharp second harmonic peak. We have employed a spectral fitting procedure to eliminate the MPF contribution to extract β from the normalized SH intensity [2]. The second harmonic response originates from the surface of the CNPs since the bulk is more or less centrosymmetric and cannot contribute to SH scattering in a big way.

I will also present how protein adsorption on CNPs change the SH light scattering intensity and show how the adsorption of proteins on the CNP surface can be modelled using various adsorption isotherms.

References

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