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PII:	S1386-1425(17)30604-2
DOI:	doi: 10.1016/j.saa.2017.07.045
Reference:	SAA 15332
To appear in:	*Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy*
Received date:	4 March 2017
Revised date:	12 May 2017
Accepted date:	22 July 2017

Please cite this article as: Jayasmita Jana, Teresa Aditya, Mainak Ganguly, Shyamal Kumar Mehetor, Tarasankar Pal , Fluorescence enhancement via varied long-chain thiol stabilized gold nanoparticles: A study of far-field effect, *Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy* (2017), doi: 10.1016/j.saa.2017.07.045

Fluorescence Enhancement via Varied Long-Chain Thiol Stabilized Gold Nanoparticles: A Study of Far-Field Effect

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Abstract

Metal enhanced fluorescence of carbon dots has been reported in aqueous solution. Moderately fluorescing carbon dots (λ_{ex}= 360 nm and λ_{em}= 440 nm) of 6-8 nm diameters (CDA) have been synthesized from freshly prepared aqueous ascorbic acid solution under modified hydrothermal treatment. The CDA fluorescence is quenched at the close proximity with gold nanoparticles (AuNPs). Here, a substrate specific near-field electric field distribution is pronounced. Anticipating distance dependent fluorescence enhancement phenomenon, long-chain aliphatic thiol capped AuNPs are introduced to improve fluorescence of moderately fluorescing CDAs. The long-chain aliphatic thiols act as spacers between CDA and AuNP. Interestingly, the fluorescence of CDA is observed to be enhanced successively as the chain lengths of aliphatic thiols are increased. Fluorescing CDA, upon excitation, transfers energy to the nearby AuNP and a plasmon is induced. This plasmon radiates in the far-field resulting in fluorescence enhancement of CDAs. Such an interesting enhancement in emission with metallic gold is termed as gold enhanced fluorescence. This far-field effect for fluorescence enhancement of CDA particles becomes a general consensus in solution with varied long-chain aliphatic amine ligand capped silver nanoparticles (AgNPs). Finally, consequence of far-field effect of fluorescence enhancement has been observed while derivatized AuNP and AgNP are introduced into the CDA solution simultaneously which is described as reinforced fluorescence enhancement due to coupled plasmonic radiation.

Keywords: Gold enhanced fluorescence; Carbon dots; Thiols; Chain length.