

Photophysics of a Coumarin Molecule in Graphene Oxide Containing Reverse Micelle

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Abstract : Graphene oxide (GO) is the two-dimensional (2D) nanoscale allotrope of carbon having several physiochemical properties such as high mechanical strength, high surface area, strong thermal and electrical conductivity makes it an important candidate in various modern applications such as drug delivery, supercapacitors, sensors etc. GO has been used in the photothermal treatment of cancers and Alzheimer's disease etc. The main idea to choose GO in our work is that it is a surface active molecule, it has a large number of hydrophilic functional groups such as carboxylic acid, hydroxyl, epoxide on its surface and in basal plane. So it can easily interact with organic fluorophores through hydrogen bonding or any other kind of interaction and easily modulate the photophysics of the probe molecules. We have used different spectroscopic techniques for our work. The Ground-state absorption spectra and steady-state fluorescence emission spectra were measured by using UV-Vis spectrophotometer from Shimadzu (model-UV-2550) and spectrofluorometer from Horiba Jobin Yvon (model-Fluoromax 4P) respectively. All the fluorescence lifetime and anisotropy decays were collected by using time-correlated single photon counting (TCSPC) setup from Edinburgh instrument (model: LifeSpec-II, U.K.). Herein, we described the photophysics of a hydrophilic molecule 7-(n,n-diethylamino) coumarin-3-carboxylic acid (7-DCCA) in the reverse micelles containing GO. It was observed that photophysics of dye is modulated in the presence of GO compared to photophysics of dye in the absence of GO inside the reverse micelles. Here we have reported the solvent relaxation and rotational relaxation time in GO containing reverse micelle and compare our work with normal reverse micelle system by using 7-DCCA molecule. Normal reverse micelle means reverse micelle in the absence of GO. The absorption maxima of 7-DCCA were blue shifted and emission maxima were red shifted in GO containing reverse micelle compared to normal reverse micelle. The rotational relaxation time in GO containing reverse micelle is always faster compare to normal reverse micelle. Solvent relaxation time, at lower w_0 values, is always slower in GO containing reverse micelle compare to normal reverse micelle and at higher w_0 solvent relaxation time of GO containing reverse micelle becomes almost equal to normal reverse micelle. Here emission maximum of 7-DCCA exhibit bathochromic shift in GO containing reverse micelles compared to that in normal reverse micelles because in presence of GO the polarity of the system increases, as polarity increases the emission maxima was red shifted an average decay time of GO containing reverse micelle is less than that of the normal reverse micelle. In GO containing reverse micelle quantum yield, decay time, rotational relaxation time, solvent relaxation time at $\lambda_{ex}=375$ nm is always higher than $\lambda_{ex}=405$ nm, shows the excitation wavelength dependent photophysics of 7-DCCA in GO containing reverse micelles.

Keywords : photophysics, reverse micelle, rotational relaxation, solvent relaxation

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