FLUORESCENCE OF C\textsubscript{60} IN SOLUTIONS AT ROOM TEMPERATURE

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**Abstract:** Strong, medium and weak fluorescence spectra for C\textsubscript{60} in different solutions at room temperature are reported for the first time, which indicate that intensity of fluorescence is dependent on the interaction between C\textsubscript{60} and solvent. It is shown that the solvents of effective electron donors could make a comparatively strong interaction with fullerenes due to the formation of the charge transfer adduct, which could greatly distort the molecular symmetry and lead to the strong fluorescence.

Since the discovery of fullerene, the photophysical properties of C\textsubscript{60} have been extensively studied [1-3]. However, the low-lying electronic transitions in C\textsubscript{60} are weakly allowed due to the high icosahedral symmetry of C\textsubscript{60}, which leads to the small fluorescence radiative. The environmental effects, the rare gas matrix perturbation effect and the low-temperature effect, for example, could relax the selection rules of C\textsubscript{60} and lead to a high fluorescence radiation rate [4-5]. However, few reports about fluorescence spectra of fullerenes at room-temperature solutions have been reported, and only weak and broad fluorescence spectra for C\textsubscript{60} were observed [6-7]. At room temperature, in commonly employed solutions such as toluene, benzene, CCl\textsubscript{4} et al, the fullerenes tend to preserve highly molecular symmetry.

It is indicate that intensity of fluorescence for C\textsubscript{60} is dependent on the interaction between C\textsubscript{60} and the solvents. The observed fluorescence of C\textsubscript{60} in room-temperature toluene solution is weak and broad as shown in Fig.1 which demonstrates that the C\textsubscript{60} only makes a weak interaction with the toluene solution. The recorded medium fluorescence for C\textsubscript{60} in CS\textsubscript{2} as displayed in Fig.2 indicates that the interaction between C\textsubscript{60} and CS\textsubscript{2} is slight stronger that that of between C\textsubscript{60} and toluene. Therefore, the symmetry of C\textsubscript{60} is partly distorted due to this medium interaction. DMSO is an effective electron donor and C\textsubscript{60} is a potential electron. Charge transfer has occurred between C\textsubscript{60} and DMSO, which was proved by the electrochemical reduction of C\textsubscript{60} as shown in fig.3. Therefore, the interaction between C\textsubscript{60} and DMSO is strong due to the formation of C\textsubscript{60}- DMSO charge transfer adduct. The fluorescence radiation rate is increased greatly, arising from symmetry lowering and selection rule relaxing of C\textsubscript{60} induced by the formation of C\textsubscript{60}- DMSO adduct.

The solvents of effective electrons donors could make a comparatively strong interaction with fullerenes due to the formation of the charge transfer adduct, which could greatly distort the molecular symmetry and lead to the strong fluorescence. Choosing appropriate molecule to form fullerene charge transfer adduct system may offer a new approach for the fabrication of novel fullerene-based luminescent materials.
Fig. 1 fluorescence spectra for C₆₀ at room temperature with excitation at 400nm:
  a. weak fluorescence spectrum for C₆₀ in toluene solution
  b. medium fluorescence spectrum for C₆₀ in CS₂ solution
  c. strong fluorescence spectrum for C₆₀ in DMSO solution

Fig. 2 Cyclic voltammogram for the reduction of C₆₀ in DMSO containing 0.1 M (TBA)ClO₄ as a supporting electrolyte at room temperature. The counter and working electrodes were Pt, while Ag wire was used as reference electrode. The scan rate was 100 mv/s.

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References: