

Resonance Energy Transfer in New Fullerene–Coumarin Diads

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Abstract The fluorescence properties of new [60] and [70] fullerene–coumarin diads are studied. These diads were synthesized by covalently linking a coumarin dye to a fullerene (C_{60} or C_{70}) by a cyclopropanation reaction. The absorption and fluorescence spectra, quantum yields and lifetimes of the diads are reported. The fluorescence quenching of the coumarin moiety by the fullerene was observed in all diads, indicating the occurrence of resonance energy transfer between the coumarin and fullerene moieties.

Keywords C_{60} · C_{70} · Coumarin · Diads · Resonance energy transfer

Introduction

Fullerenes, and in particular C_{60} , have been incorporated in a wide variety of molecular structures, containing photoactive and/or electroactive units, to form donor-bridge-acceptor diads and triads [1–3]. In these molecular systems, the fullerene unit is usually the electron acceptor owing to its relatively low reduction potential, extended π -electron system and low reorganization energy [3–5]. Recently, C_{60} has been introduced in combination with electroluminescent organic conjugated polymers and oligomers as a component for organic solar cells [6–9]. In donor-bridge-acceptor systems, electronic energy transfer from the higher energy moiety to the lower energy one is also possible in principle, whenever a spec-

tral overlap between the fluorescence of the donor moiety and the absorption of the acceptor moiety exists. As is well known, in the case of transfer by the dipole–dipole mechanism, this implies a distance not larger than twice the critical radius.

The diads studied in this work were obtained by covalently linking a coumarin dye (donor) to fullerene (acceptor) by the cyclopropanation reaction [3]. Two coumarin derivatives and two different spacers (rigid/flexible) were used. Here we report the fluorescence properties of the diads and discuss the fluorescence quenching process of the coumarin moiety by the fullerene moiety.

Experimental

C_{60} (99.5%, Aldrich), C_{70} (99%, Aldrich), anthracene (Fluka), and coumarin 1 (99%, Fluka) were used as received. All solvents used were of spectroscopic grade. The synthesis of the coumarin derivatives and diads will be described elsewhere.

Spectral measurements were made with standard 1 cm quartz cells at room temperature. Electronic absorption spectra were measured using a Shimadzu 3101 UV/Vis/NIR spectrophotometer. Fluorescence spectra were obtained with a SPEX Fluorolog F112A fluorimeter, equipped with a 1681 0.22 m single monochromator on the excitation side and a 1680 0.22 m double monochromator on the emission side. Fluorescence quantum yields in room temperature toluene were determined by a comparative method, using anthracene ($\phi_F = 0.27$ [10]) and coumarin 1 ($\phi_F = 0.73$ [11]) in air-saturated ethanol as the fluorescence standard for coumarin derivatives **I** and **IV**, respectively. Fluorescence quantum yields of the diads **II** and **III** in room temperature toluene were determined using anthracene ($\phi_F = 0.27$ [10])

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