Diffusion-Limited Energy Transfer in Blends of Oligofluorenes with an Anthracene Derivative.

Rodrigo Q. Albuquerque (PQ),[1*] Christiane C. Hofmann (PQ),[2] Jürgen Köhler (PQ),[2] Anna Köhler (PQ).[2]

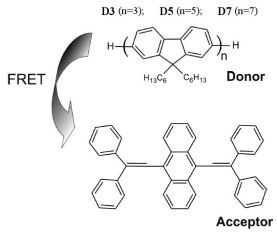
[1] Universidade de São Paulo, Instituto de Química de São Carlos, Av. Trab. São-carlense 400, São Carlos, SP – Brasil. E-mail: rodrigo_albuquerque@iqsc.usp.br
[2] University of Bayreuth, Physics Department, Universitätstr. 30, 95440 Bayreuth, Germany.

Keywords: *Resonant Energy Transfer, Point-Dipole Approximation, Energy Migration, Oligofluorenes, Fluorescence.*

Introdução

Excitation energy transfer (ET) is a key process controlling the function of many organic semi-conductor devices, such as polymer light-emitting diodes or photovoltaic cells.[1] The way energy is transferred in such solid-state devices having donor and acceptor species is still subject of investigation and can occur as a single step ET from donor to acceptor or as a sequence of donor-donor ET steps (i.e., energy migration), followed by a final nearest-neighbor donor-acceptor ET. In amorphous films of a donor host doped with a small amount of an acceptor guest, both processes can, in principle, take place, and the resulting energy transfer mechanism is likely to be a superposition of both modes.

Here, we use oligomers as well-defined model systems to investigate how the nature of energy transfer depends on oligomer length and acceptor concentration. We compare energy transfer rates using either an oligofluorene trimer, pentamer, or heptamer as the donor in combination with an anthracene derivative as the acceptor (see scheme on the left).



Resultados e Discussão

For all three oligofluorenes, a good spectral overlap between the emission from the donor and the absorption of the acceptor can be observed. Increasing the acceptor concentration leads both to the appearance of the emission band (upon donor excitation) assigned to the acceptor and to the decrease in the lifetime of the donor, proving the ET process (see Fig. 1).
The experimental ET rates were determined using[2]

$$k_{ET}(t) = -\frac{d}{dt}\ln(g(t)/f(t))$$

where *g(t)* and *f(t)* represent the time dependence of the photoluminescence of the donor in the presence and in the absence of the acceptor, respectively.

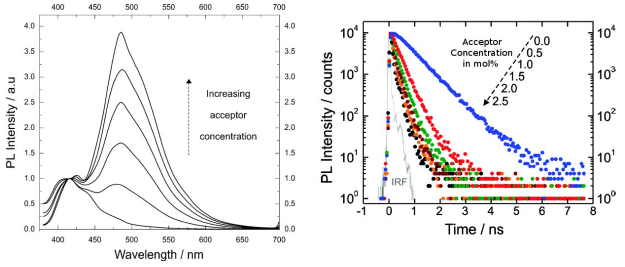


Figure 1. Left: emission spectra of a film containing **D3** and the acceptor with λ_{exc} = 355 nm. Right: photoluminescence decays of **D3** in the blend (λ_{exc} = 355, λ_{em} = 415 nm). Temperature = 298 K.

The comparison between experimental ("EXP") and theoretical ("PDA", Förster-based[3]) ET rates are shown in Fig. 2 for all investigated blends.

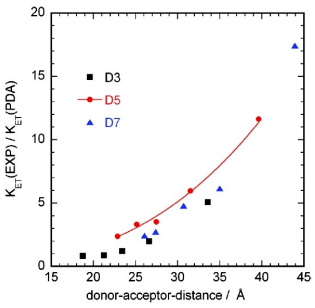


Figure 2. Ratio between k_{ET}(EXP) and k_{ET}(PDA) as a function of donor-acceptor center-to-center distance for blends of the acceptor with **D3**, **D5**, and **D7**. For the **D5** blend, the solid line indicates a fit to a $r^{2.9}$ dependence.

Conclusões

The ET process is dominated by energy migration within the donor host, meaning that it is more important to match the host oligomer length to the maximum of its electronic coupling instead of optimizing the spectral overlap integral between donor and acceptor.

Agradecimentos

Financial support from the German-Israeli Found. (I-897-221.10/2005) and from the German Science Found. (GRK 1640) are gratefully acknowledged.

[1] Blom, P. W. M.; Vissenberg, M. C. J. M. *Mater. Sci. Eng., R* **2000**, *27*, 53.
[2] Albuquerque, R. Q.; Hofmann, C. C.; Köhler, J.; Köhler, A. *J. Phys. Chem. B* **2011**, *115*, 8063.
[3] Förster, T. *Ann. Phys.* **1948**, *2*, 55.