

VIII-D Development of Organic Semiconductors for Molecular Thin-Film Devices

Organic light-emitting diodes (OLEDs) and organic field-effect transistors (OFETs) based on π -conjugated oligomers have been extensively studied as molecular thin-film devices. Organic semiconductors with low injection barriers and high mobilities are required for highly efficient OLEDs and OFETs. Radical cations or anions of an organic semiconductor have to be generated easily at the interface with an electrode (or a dielectric), and holes or electrons must move fast in the semiconducting layer. Compared with organic p -type semiconductors, organic n -type semiconductors for practical use are few and rather difficult to develop. Recently, we found that perfluorinated oligomers are efficient electron-transport materials for OLEDs.

VIII-D-1 Oligo(2,6-Anthrylene)s: Acene-Oligomer Approach for Organic Field-Effect Transistors

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[*Angew. Chem., Int. Ed.* **42**, 1159–1162 (2003)]

Oligo(2,6-anthrylene)s (**2A** and **3A**) and their dihexyl derivatives (**DH-2A** and **DH-3A**) have been synthesized by the Suzuki coupling using palladium catalysts. Organic field-effect transistors (OFETs) of these anthracene oligomers were fabricated on SiO₂/Si substrates by high-vacuum evaporation. OFETs with **2A** exhibited FET activity, and the hole mobilities ranged from 0.0031 to 0.013 cm²V⁻¹s⁻¹. The oligomer **3A** showed even higher mobilities (0.064–0.072 cm²V⁻¹s⁻¹). Field-effect mobilities of **DH-2A** were greater than 0.1 cm²V⁻¹s⁻¹. The highest mobilities (0.18 cm²V⁻¹s⁻¹) were observed in **DH-3A** OFETs. X-ray diffraction studies on the films indicated a high degree of lamellar ordering and crystallinity.

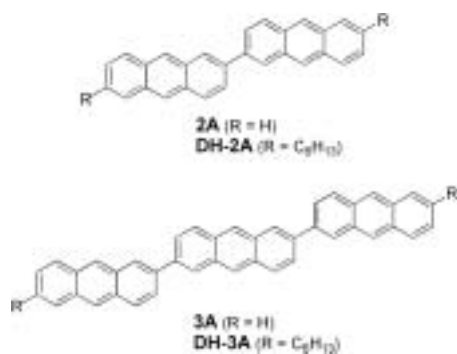


Figure 1. Structures of anthracene oligomers.

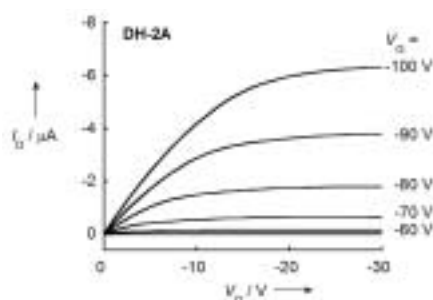


Figure 2. Drain current (I_D) vs drain voltage (V_D) as a function of gate voltage (V_G) for an OFET with **DH-2A** ($T_{\text{sub}} = 70$ °C). Channel length $L = 100$ μm and channel width $W = 1$ mm ($W/L = 10$).

VIII-D-2 Color Tunable Organic Light-Emitting Diodes Using Pentafluorophenyl-Substituted Iridium Complexes

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[*Adv. Mater.* **15**, 1455–1458 (2003)]

Novel iridium complexes with perfluorophenyl-substituted phenylpyridine ligands have been developed. The figure shows the photoluminescence (PL) spectra of four complexes in the doped films. By changing the position of substitution, the peaks in the PL spectra are tuned in the wavelength region 513–578 nm. Light-emitting diodes using these complexes as the emitting material show an external quantum efficiency of 10–17%.

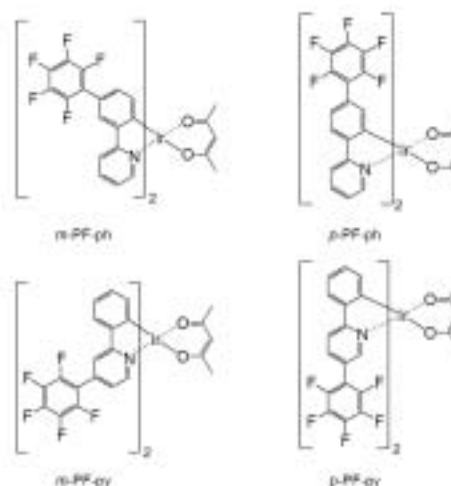


Figure 1. Structures of iridium complexes.

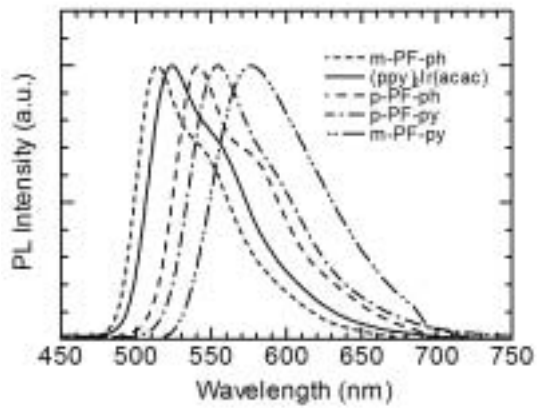


Figure 2. PL Spectra for films of the complexes (6%) doped in CPB.