Research Center for Molecular-Scale Nanoscience

VIII-C 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-C-1 Perfluoro-1,3,5-tris(*p*-Oligophenyl) benzenes: Amorphous Electron-Transport Materials with High Glass-Transition Temperature and High Electron Mobility

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Perfluoro-1,3,5-tris(*p*-quaterphenyl)benzene (**PF-13Y**) and perfluoro-1,3,5-tris(*p*-quinquephenyl)benzene (**PF-16Y**) have been synthesized and characterized. They showed higher glass transition temperatures compared with perfluoro-1,3,5-tris(*p*-terphenyl)benzene (**PF-10Y**). Organic light-emitting diodes (OLEDs) were fabricated using these materials as the electron-transport layers. **PF-13Y** and **PF-16Y** are better electron-transporters than **PF-10Y**. The electron mobilities of **PF-10Y** and Alq_3 were measured by the time-of-flight technique. **PF-10Y** showed higher electron mobilities (10^{-4} cm^2/Vs) and weaker electric field dependence compared with Alq_3.

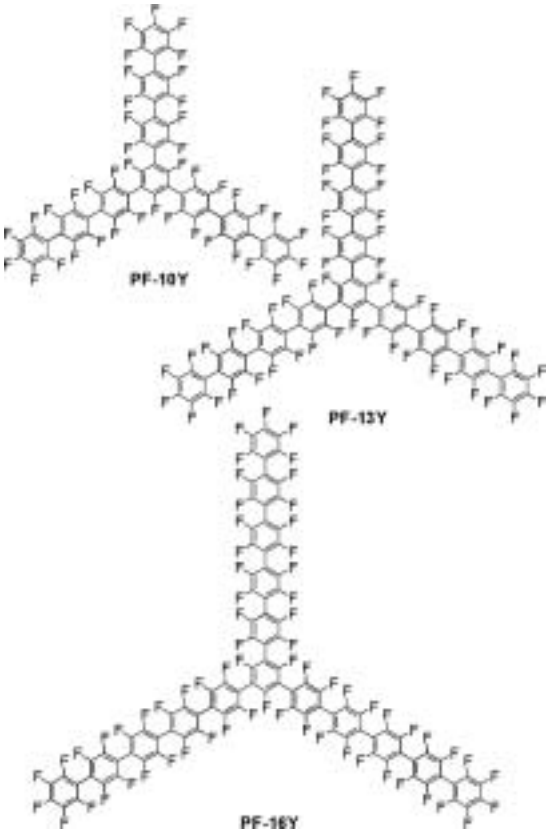

Figure 1. Perfluoro-1,3,5-tris(*p*-oligophenyl)benzenes.

VIII-C-2 Synthesis and Properties of Iridium Complexes Bearing Perfluoroaryl-Substituted 2-Phenylpyridine

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Perfluorophenyl derivatives of 2-phenylpyridine, 2-(*p*-C_6F_5-phenyl)pyridine (**1a**), 5-C_6F_5-2-phenylpyridine (**1b**), and 5-C_6F_5-2-(*p*-C_6F_5-phenyl)pyridine (**1c**), have been prepared. Their iridium(III) acetylacetonato complexes (**2a-c**) were satisfactory synthesized in a one-pot reaction of a free ligand and an iridium salt in 2-ethoxyethanol at 105 °C, and the subsequent reaction

with acetylacetone in the presence of a base at 50 °C for 4 h. When the reaction was carried out at 140 °C, the substitution reaction of fluoride with 2-ethoxyethoxide at para position took place. When applied to OLED devices, compounds **2a-c** showed emissions from greenish yellow to yellow at room temperature with the external quantum efficiency up to 14.7%.

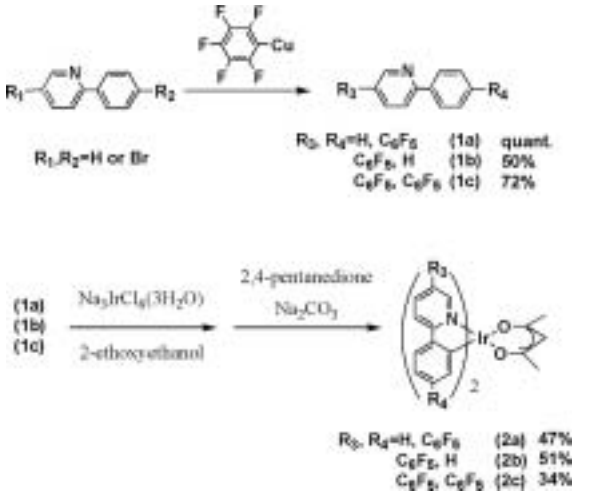

Figure 1. Synthesis of C_6F_5-substituted ppy and their iridium acac derivatives.