VIII-J Organic Molecular Materials with Novel Electronic Properties

Some aromatic and heterocyclic compounds show intriguing physical properties, such as superconductivity, ferromagnetism, and electroluminescence, in the solid state. The aim of our research is to design and synthesize such molecules. We have been working on three research projects: synthesis of organic conductors, fullerene chemistry, and organic electroluminescent (EL) materials.

VIII-J-1 Synthesis and Electron-Transporting Properties of Perfluorinated Decaphenylenes

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Recently, π-conjugated oligomers such as oligophenylenes and oligothiophenes have gained considerable attentions as organic electronic materials. Unlike polymers, these oligomers are monodisperse and can form clean thin films by vacuum deposition. If an electron-deficient oligomer forms a stable amorphous film and transports electrons with high mobility, it will be a good candidate for an electron-transporting material, which is an important component of highly efficient organic electroluminescent (EL) devices. Perfluorinated benzene rings are positively charged due to electronegative fluorine atoms and show intriguing interactions with electron-donating molecules due to quadrupole moments. We have developed the repetitive synthesis method of perfluorinated phenylenes **1-3** containing 10 phenyl rings. All $C_{60}F_{42}$s are colorless solid and soluble in CH_3Cl, THF, and aromatic solvents such as toluene. The differential scanning calorimetry (DSC) curves indicated that decaphenylenes **1-3** have the glass transitions at T_g = 123, 128, and 131 °C, respectively. The reduction potential peaks of the cyclic voltammograms (CV) shift more negative in the order **3** (–2.17 V), **2** (–2.24 V), and **1** (–2.49 V vs Fc/Fc^+) in THF. We fabricated organic EL devices with these perfluorinated compounds **1-3** to examine their electron-transporting properties. The luminance-voltage curves (Figure 1) indicated that **3** has the best electron-transporting ability in the three compounds.

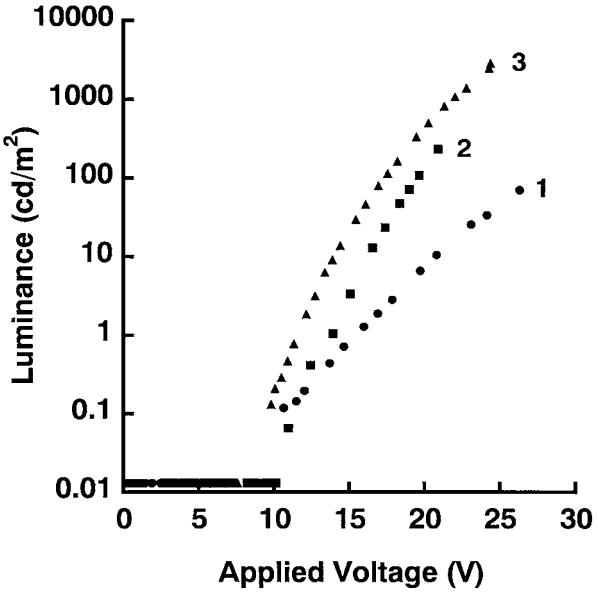

Figure 1. Luminance-voltage characteristics for the EL devices with **1-3** as electron-transporting layers: ITO/TPTE (60 nm)/Alq_3 (40 nm)/**1-3** (20 nm)/LiF (0.5 nm)/Al (160 nm).