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高い溶解性を持つ発光性高分子：ポリ［2-(9,9-ビスヘキシルフルオレニル)-1,4-フェニレンビニレン］の合成と発光特性

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Highly soluble emissive polymer:Poly[2-(9,9-bishexylfluorenyl)-1,4-phenylenevinylene]s

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Poly(*p*-phenylenevinylene) (PPV) and its derivatives have been known to be conjugated polymers for optoelectronic applications, such as light-emitting diodes (LEDs), photovoltaic diodes, and photodetectors. Many efforts have been focused on designing PPV derivatives with 2-substitued or 2,5-disubstituted alkoxy groups on the aromatic rings in order to improve quantum efficiency as well as obtain high solubility. We found that incorporating dialkylfluorenyl groups to the PPV backbone was quite effective for the increase of emission efficiency of PLEDs with maintaining high processability[1,2]. With the starting materials, 2-bromofluorene and 2,7-dibromofluorene, we synthesized three kinds of polymers, poly[2-(7`-R-9`,9`-bishexylfluorenyl)-1,4-phenylenevinylene]s (R=H;BHF-PPV, R=OCH_3;MBHF-PPV, R=CN;CNBHF-PPV) using the modified Gilch procedure. BHF-PPV and MBHF-PPV were bright greenish yellow and yellow fibrous materials, respectively, with good solubility in common organic solvents such as THF, toluene, or chloroform, and formed good transparent thin films on the ITO-coated glass substrates. The number average molecular weights (M_n) and weight average molecular weights (M_w) of the polymers, determined by GPC measurement with polystyrene as the calibration standard, were in the range of 168000-214000 and 329000-354000 with polydispersity index of 1.54-2.11. CNBHF-PPV was partially soluble in THF and chloroform. UV-vis absorption and photoluminescence (PL) spectra of BHF-PPV and MBHF-PPV as solid film spin-coated on a quartz plate are shown in Figure 1. The UV-vis absorption spectrum of BHF-PPV displays three peaks at 279, 311, and 428 nm. MBHF-PPV film shows three maximum wavelengths of 291, 323, and 428 nm. It was observed that there is some difference between PL spectra of BHF-PPV and MBHF-PPV. The PL spectrum of BHF-PPV shows two peaks of 502 and 530 nm, while the PL spectrum of MBHF-PPV displays two maximum wavelengths of 510 and 528 nm, which slightly red-shifted compared to that of BHF-PPV. Figure 2 shows the current density-voltage (I-V) and luminance-voltage (L-V) relationship for device fabricated using BHF-PPV (130 nm) as the emissive layer, PEDOT:PSS (50 nm) as the hole-injection layer, and Mg-Ag alloy layer (150 nm) as the cathode. By applying the electric voltage, blue-green emission of BHF-PPV was observed at 504 and 535 nm, which very closely resembled the PL spectrum of the corresponding polymer film. This means that the same excitations are involved in both cases. Blue-green LED fabricated with BHF-PPV showed turn-on voltage of 3.0 V, and exhibited luminance efficiency and power efficiency of 0.64 cd/A and 0.45 lm/W, respectively, at the luminance of 105.1 cd/m^2 driven at the voltage of 4.5 V and current density of 16.37 mA/cm^2.

1) Sang Ho Lee, Bo-Bin Jang, and Tetsuo Tsutsui, *Chem. Lett.*, 1184 (2000).
2) Sang Ho Lee, Bo-Bin Jang, and Tetsuo Tsutsui, *SPIE Proceedings*, in press (2000).

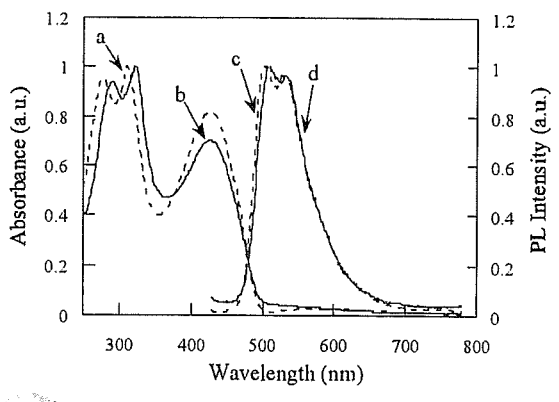

Fig. 1 UV-vis absorption and photoluminescence of BHF-PPV (a, c) and MBHF-PPV (b, d)

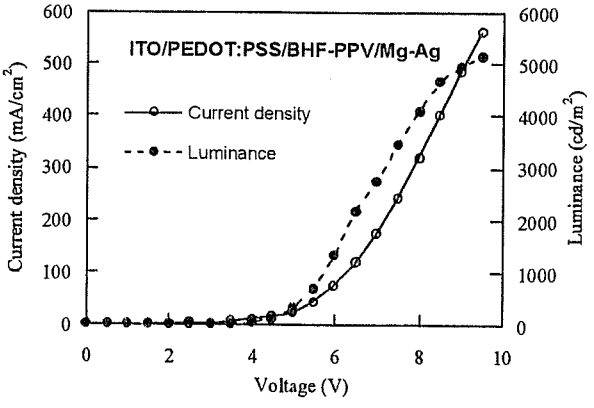

Fig. 2. Current density-voltage-luminance (I-V-L) characteristics of an ITO/PEDOT:PSS/BHF-PPV/Mg-Ag device.