

Supplementary Information

Synthesis and Properties of Hyperbranched Polymers for White Polymer Light-Emitting Diodes

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Supporting Information includes:

Section S1. General Experimental Information

Section S2. Device Fabrication and Characterization

Section S3. Structure and characterization

Figure S1. ¹H NMR spectrum of **DBrCz**.

Figure S2. ¹³C NMR spectrum of **DBrCz**.

Figure S3. ¹H NMR spectrum of **Ir(Brpiq)₂acac**.

Figure S4. ¹H NMR spectra of the hyperbranched polymers.

Figure S5. PL spectra of **PFCz** and UV-vis spectra of **Ir(pi_q)₂acac** in CHCl₃ solution (10⁻⁵ M).

Section S1. General Experimental Information

Materials and Characterization

In this work, 9,9-Dioctylfluorene-2,7-bis(trimethyleneboronate) (**M2**, 99.5%) was purchased from Synwitech. Tetrahydrofuran (THF) and toluene were distilled using standard procedures. Other solvents were used without further purification unless otherwise specified. All reactions were carried out using Schlenk techniques under dry nitrogen atmosphere. ^1H NMR and ^{13}C NMR spectra were measured using a Bruker DRX 600 spectrometer, and chemical shifts were reported in ppm using tetramethylsilane as an internal standard. Elemental analysis (EA) was performed with a Vario EL elemental analyzer. Molecular weights and polydispersities of the copolymers were determined using gel permeation chromatography (GPC) on an HP1100 high performance liquid chromatograph (HPLC) system equipped with a 410 differential refractometer, and a refractive index (RI) detector, with polystyrenes as the standard and THF as the eluent at a flow rate of 1.0 mL/min at 30 °C. The UV-visible absorption spectra were determined on a Hitachi U-3900 spectrophotometer and the PL emission spectra were obtained using a Horiba FluoroMax-4 spectrophotometer at room temperature. The PL lifetime of the hyperbranched porous polymers was measured by Edinburgh Instrument FLS980 spectrometer equipped with an EPL-375 picosecond pulsed diode laser in the 10^{-5} mol/L CH_2Cl_2 solution at room temperature. Thermogravimetric analysis (TGA) of the copolymers was conducted by a Setaram thermogravimetric analyzer at a heating rate of 10 °C/min under nitrogen atmosphere. Differential scanning calorimetry (DSC) measurements were performed at both heating and cooling rates of 5 °C/min under nitrogen atmosphere, using DSC Q100 V9.4 Build 287 apparatus. Powder X-ray diffraction measurements were performed by a Bruker X-ray diffractometer. Atomic force microscopy (AFM) measurements were performed using an SPA-300HV from Digital Instruments Inc. (Santa Barbara, CA) at a tapping mode. Cyclic voltammetry (CV) measurements were performed on an Autolab/PG STAT302 electrochemical workstation with the thin film of the hyperbranched porous polymers on the working

electrode in a solution of tetrabutylammonium hexafluorophosphate (Bu_4NPF_6 , 0.1 M) in acetonitrile (CH_3CN) at a scanning rate of 50 mV/s at room temperature under nitrogen atmosphere. A Pt plate was used as the counter electrode, and a saturated calomel electrode was used as the reference electrode.

Section S2. Device Fabrication and Characterization

Patterned glass substrates coated with indium tin oxide (ITO) ($20 \Omega \text{ square}^{-1}$) were cleaned by a surfactant scrub, washed successively with deionized water, acetone and isopropanol in an ultrasonic bath, and then dried at $120 \text{ }^\circ\text{C}$ in a heating chamber for 2 h. A 40-nm-thick poly(3,4-ethylenedioxythiophene) : poly(styrenesulfonic acid) (PEDOT:PSS) hole injection layer was spin-coated on top of ITO and baked at $120 \text{ }^\circ\text{C}$ for 20 min. Thin films (50 nm thick) of the hyperbranched porous polymers as light-emitting layer were deposited on top of the PEDOT:PSS layer by spin-coating the chlorobenzene solution of the hyperbranched porous polymers, followed by thermal annealing at $110 \text{ }^\circ\text{C}$ for 20 min. Then an electron-transporting layer of 1,3,5-tris(N-phenylbenzimidazol-2-yl)benzene (TPBi, 35 nm), a electron injection layer of LiF (1 nm), and a cathode layer of Al (150 nm) were deposited by vacuum evaporation under a base pressure of $5 \times 10^{-4} \text{ Pa}$. The EL spectra and CIE coordinates were measured with a PR-655 spectra colorimeter. The current-voltage-forward luminance curves were measured using a Keithley 2400 source meter and a BM-7A luminance meter.

Section S3. Structure and characterization

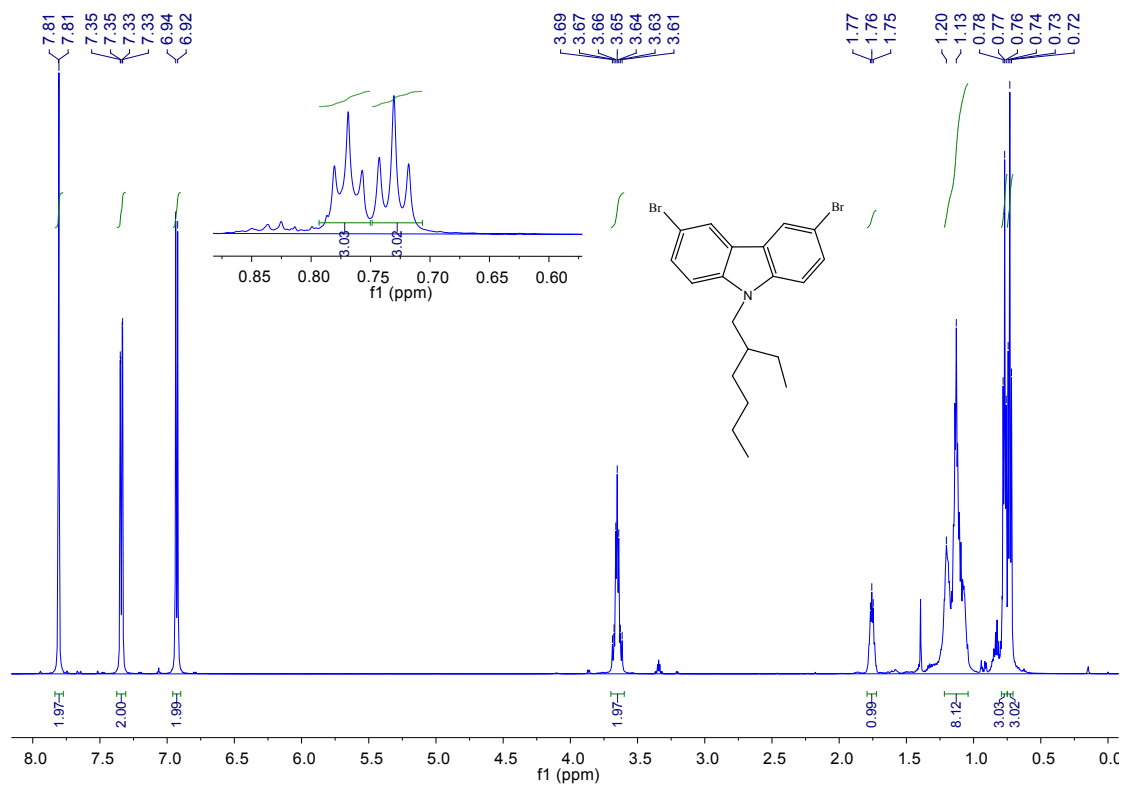


Figure S1. ^1H NMR spectrum of DBrCz.

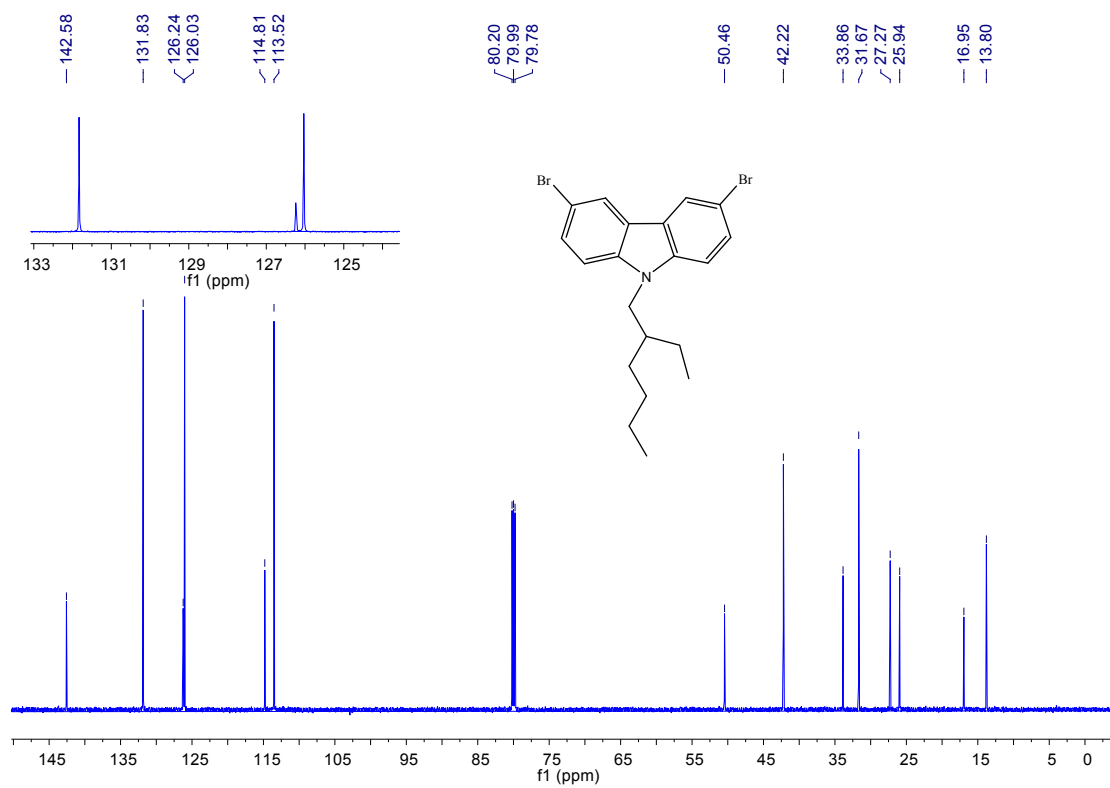


Figure S2. ^{13}C NMR spectrum of DBrCz.

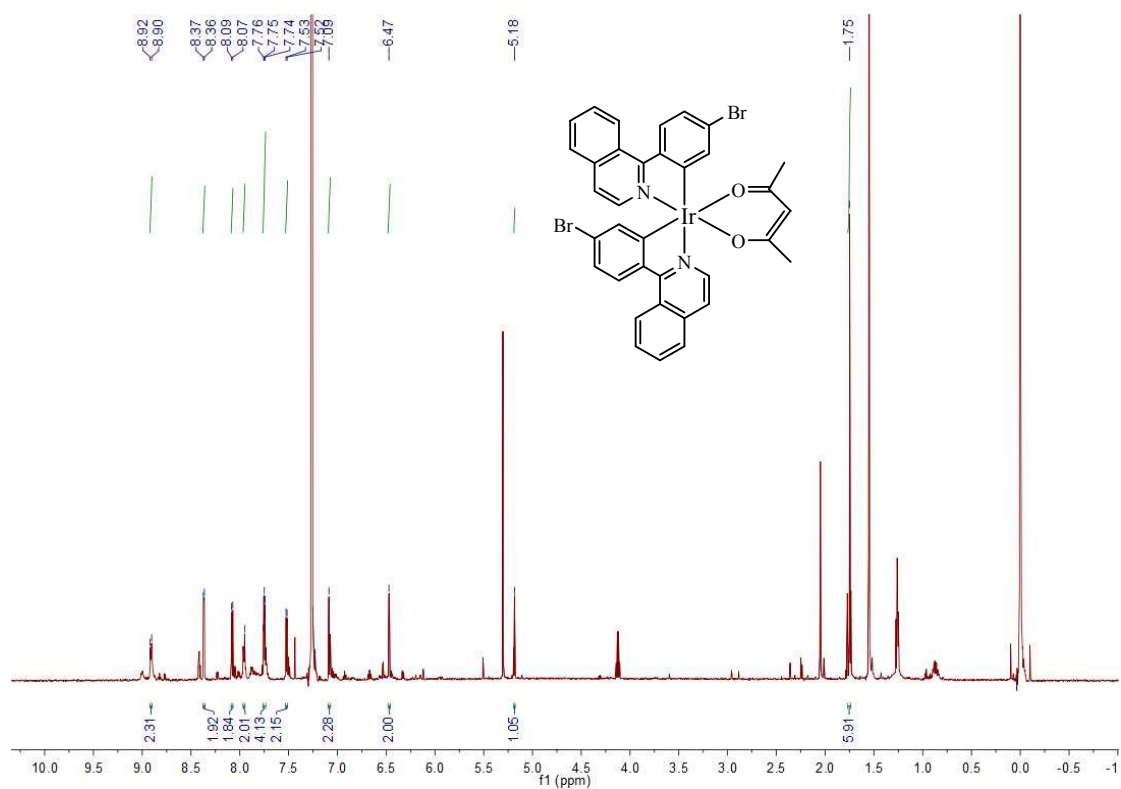


Figure S3. ^1H NMR spectrum of $\text{Ir}(\text{Brpiq})_2\text{acac}$.

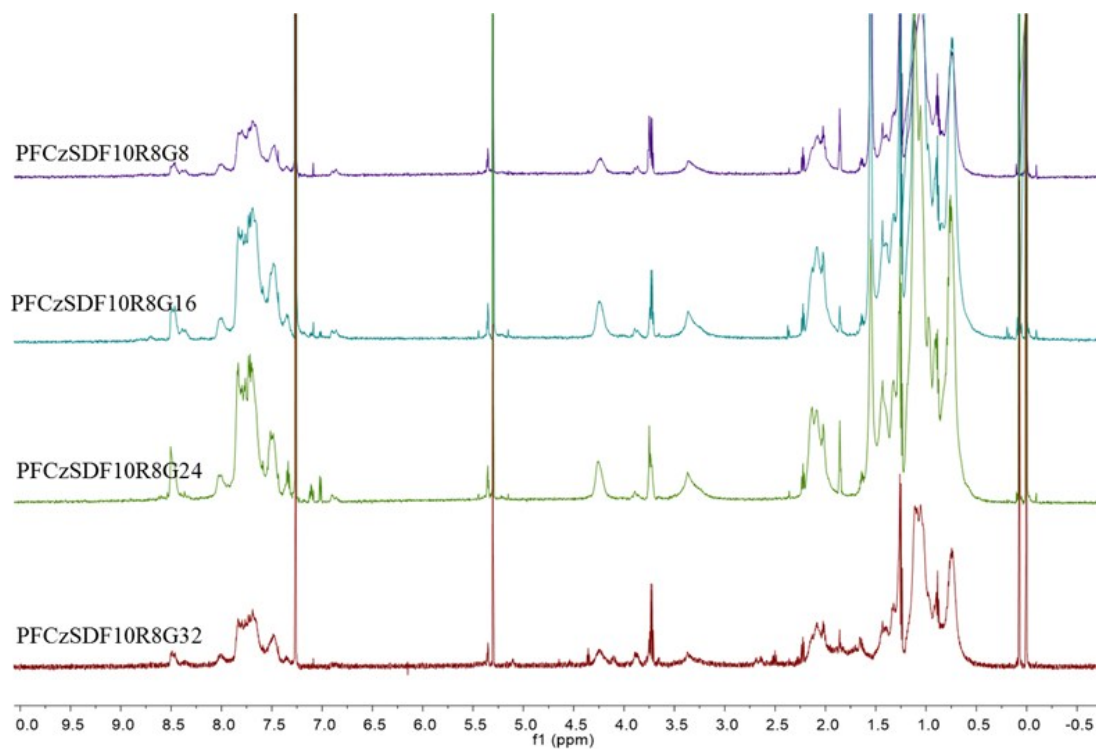


Figure S4. ^1H NMR spectra of the hyperbranched polymers.

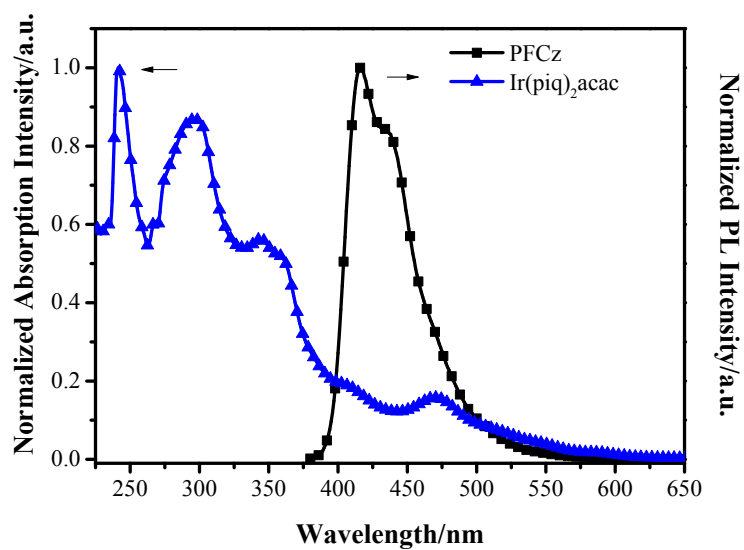


Figure S5. PL spectra of **PFCz** and UV-vis spectra of **Ir(piq)₂acac** in CHCl₃ solution (10⁻⁵ M).

References and Notes

1. C. Liu, Q. Fu, Y. Zou, C. Yang, D. Ma, J. Qin, *Chem. Mater.* 2014, **26**, 3074-83.