Supporting Information

Charge mobility enhancement for diketopyrrolopyrrole-based conjugated polymers by partial replacement of branching alkyl chains with linear ones

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1. Characterization techniques

^{1}H NMR and ^{13}C NMR spectra were recorded on Bruker AVANCE III 500, 400, and 100 MHz spectrometers. Elemental analysis was measured with a Carlo Erba model 1160 elemental analyzer. UV−vis absorption spectra were measured with JASCO V-570 UV−vis spectrophotometer. Gel permeation chromatography (GPC) analysis was performed on an PL-GPC 220 high-temperature chromatograph at 150°C equipped with a IR5 detector; polystyrene was used as the calibration standard and 1,2,4-trichlorobenzene as eluent (the flow rate was 1.0 mL/min). Thermogravimetric analysis (TGA) were performed on a Shimadzu DTG-60 instruments under a dry nitrogen flow with the temperature from room temperature to 550 °C (10 °C/min). For differential scanning calorimetry (DSC) measurements ~5 mg of the sample was used and the measurement was conducted under nitrogen at a scan rate of 10 °C/min with a DSC-Q2000 instrument. Cyclic voltammetric measurements were carried out in a conventional three-electrode cell using a glassy carbon working electrode, a Pt counter electrode, and a Ag/AgCl (saturated KCl) reference electrode on a computer-controlled CHI660C instruments at ambient temperature; *n*-Bu_4NPF_6 (0.1 M) was used as the supporting electrolyte. The onset oxidation and reduction potentials were presented by reference to the redox potential of ferrocene/ferrocenium (Fc/Fc^+). Atomic-force microscopy images of thin films of polymers were taken by using a Digital Instruments Nanoscope V atomic force microscope operated in tapping mode with a Nanoscope V instrument in air. The GIXRD data of thin films of polymers were obtained at Beijing Synchrotron Raidation Facility, 1W1A.

2. Differential scanning calorimetry (DSC) curves

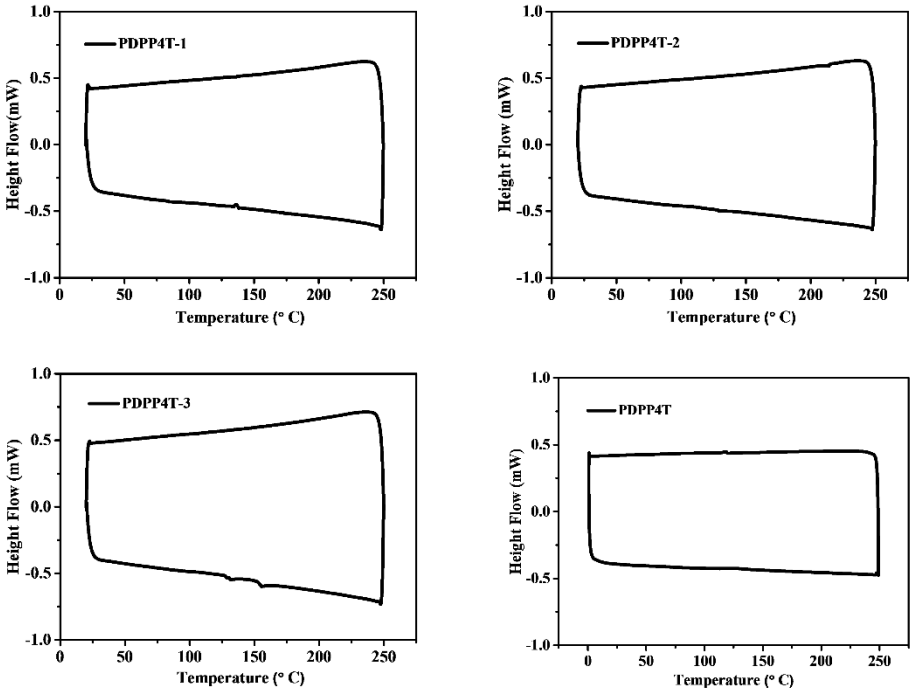


Figure S1 DSC curves of **PDPP4T-1**, **PDPP4T-2**, **PDPP4T-3**, and **PDPP4T** recorded at a heating and cooling rate (25-250 °C) of 10 °C/min under nitrogen.

3. TGA analysis

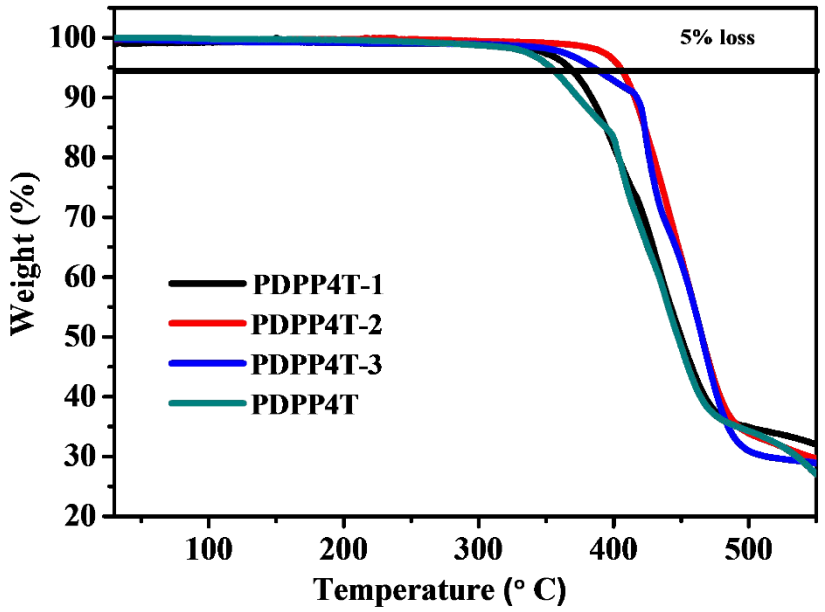


Figure S2 TGA curves of **PDPP4T-1**, **PDPP4T-2**, **PDPP4T-3** and **PDPP4T**; heating rate: 10 °C/min. from 20 °C to 550 °C under nitrogen atmosphere.

4. Cyclic voltammograms

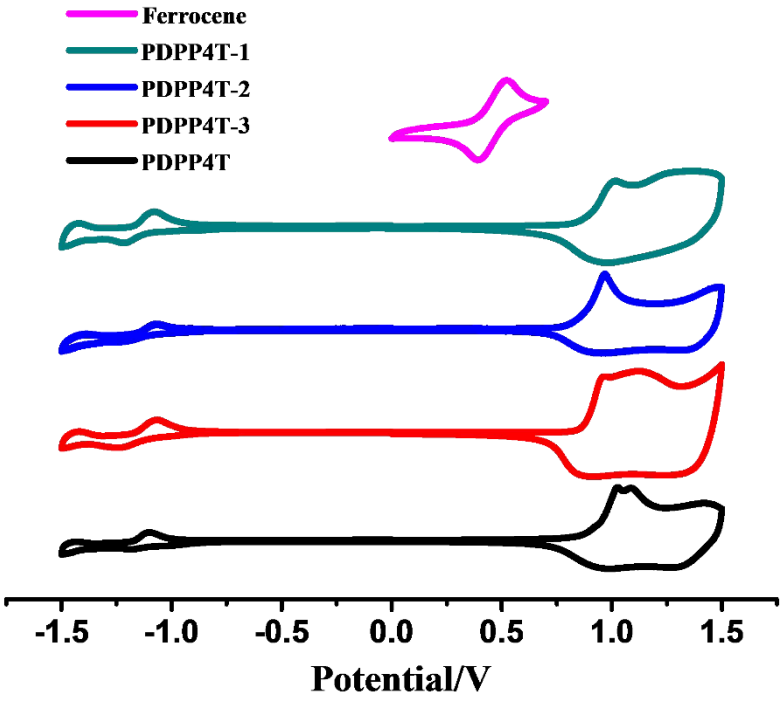


Figure S3 Cyclic voltammograms of **PDPP4T-1**, **PDPP4T-2**, **PDPP4T-3** and **PDPP4T** (in the form of thin films) at a scan rate of 100 mVs^{-1}, with Pt as the working and counter electrodes and an Ag/AgCl electrode (saturated KCl) as the reference electrode, and *n*-Bu_4NPF_6 (0.1 M) in CH_3CN as supporting electrolyte.

5. OFET device fabrication and measurements

A heavily doped *n*-type Si wafer with a dry oxidized SiO_2 layer of 300 nm and a capacitance of 11 nF cm^{-2} was employed as the gate electrode and dielectric layer. The drain-source (*D*-*S*) gold contacts were fabricated by photo-lithography. The substrates were first cleaned by sonication in acetone and water for 5.0 min., and immersed in Piranha solution (2:1 mixture of sulfuric acid and 30% hydrogen peroxide) for 20 min. The substrates were further rinsed with deionized water and isopropyl alcohol for several times. After the substrate surfaces were modified with *n*-octadecyltrichlorosilane (OTS), they were washed with $CHCl_3$, *n*-hexane and isopropyl alcohol sequentially. Next, thin films of **PDPP4T-1**, **PDPP4T-2**,

PDPP4T-3 and **PDPP4T** were prepared by spin-coating of their hot *o*-1,2-dichlorobenzene solutions (5.0 mg/mL) onto the modified substrates at 2500 rpm for 60 s. Thin films of **PDPP4T/NMe$_4$I** were prepared by adding a dimethyl sulfoxide (DMSO) solution of **NMe$_4$I** to the hot *o*-1,2-dichlorobenzene (*o*-DCB) solution of **PDPP4T,** where the **PDPP4T/NMe$_4$I** thin films were at a molar ratio of 30:1. The annealing process was performed in vacuum for 1.0 hr at 160 ºC and 200 ºC. The transfer and output curves of FETs were measured at room temperature in air using a Keithley 4200 SCS semiconductor parameter analyzer.

The mobilities were determined in the saturation regime by using the equation:

$$I_{DS} = \frac{W}{2L}\mu C_i \left(V_{GS} - V_{th}\right)^2$$

Where I_{DS} is the drain electrode collected current; L and W are the channel length and width, respectively; μ is the charge mobility of the device; C_i is the capacitance per unit area of the gate dielectric layer; V_{GS} and V_{th} are the gate and the threshold voltages, respectively. The V_{th} of the device was obtained by extrapolating the $(I_{DS,sat})^{1/2}$ vs. V_{GS} plot to $I_{DS} = 0$.

6. Transfer and output curves of BGBC devices with thin films of PDPP4T-1/NMe_4I, PDPP4T-2/NMe_4I, PDPP4T-3/NMe_4I and PDPP4T/NMe_4I.

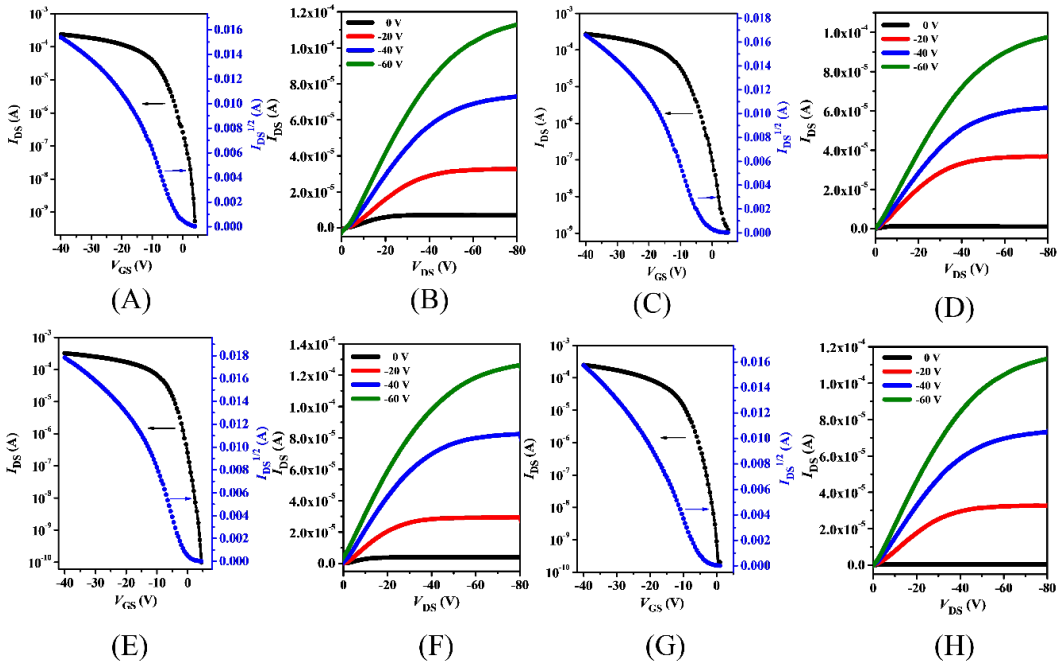
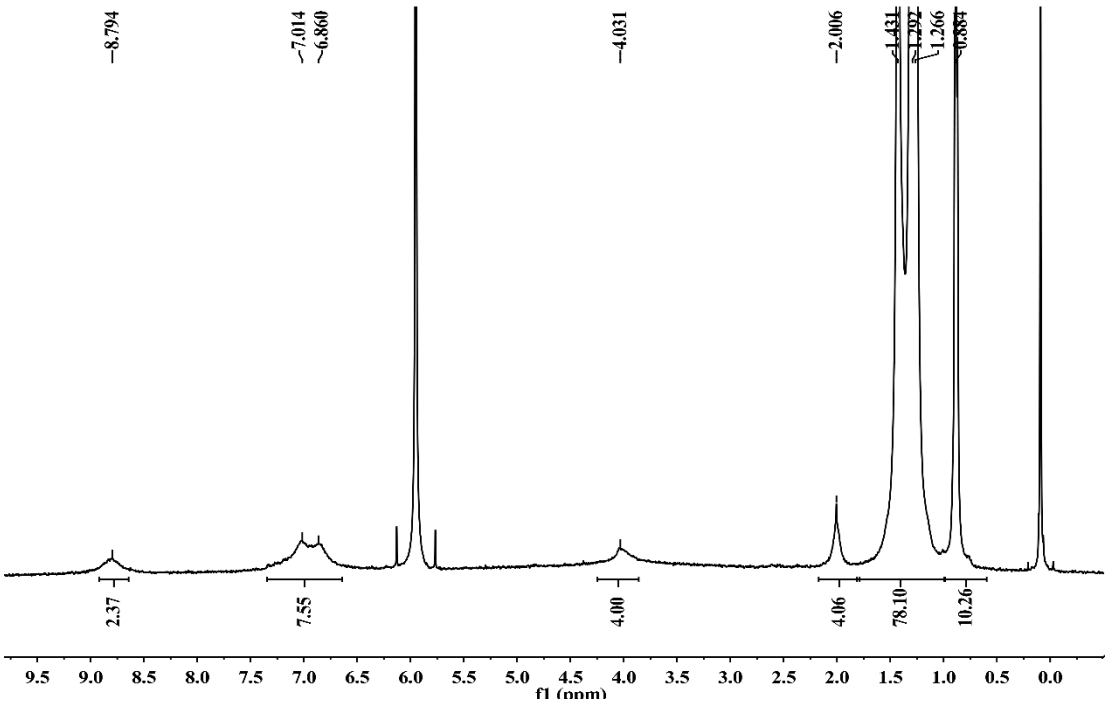


Figure S4 The transfer and output curves of BGBC FETs with thin films of **PDPP4T-1/ NMe_4I** (A, B), **PDPP4T-2/ NMe_4I** (C, D), P**DPP4T-3/ NMe_4I** (E, F) and **PDPP4T/ NMe_4I** (G, H); the channel width (W) and length (L) were 1440 μm and 50 μm, respectively.

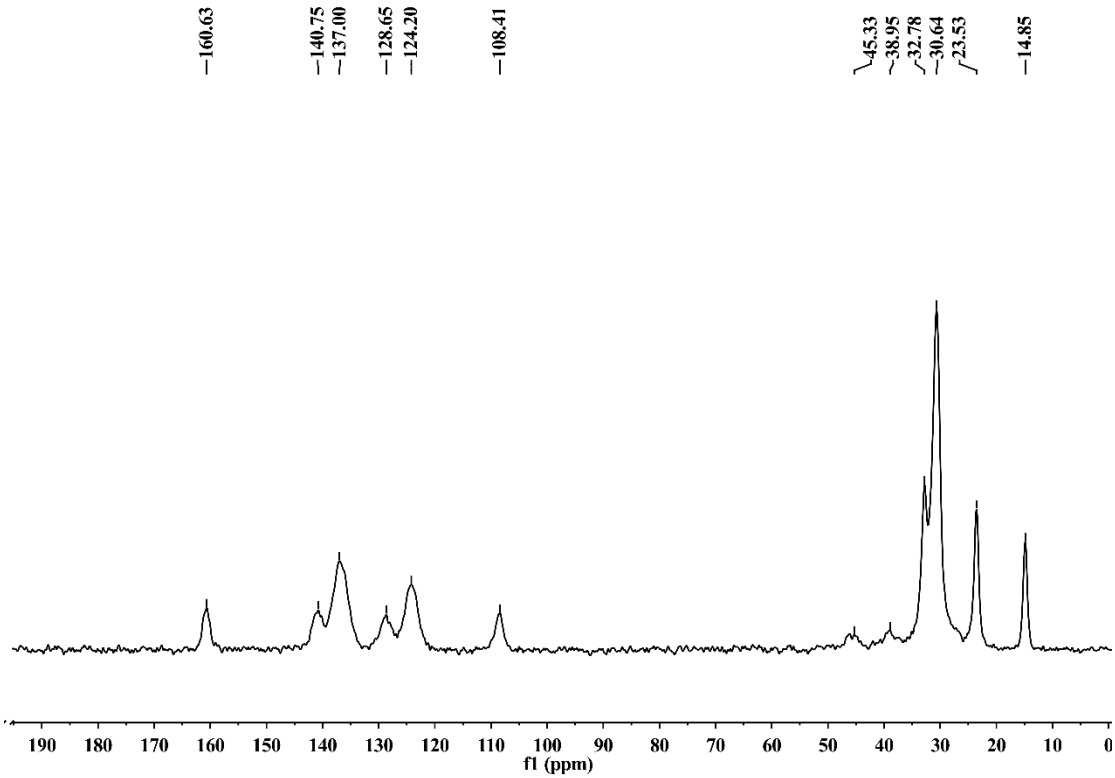
7. ^{1}H NMR and solid-state ^{13}C NMR spectra

PDPP4T-1

^{1}H NMR

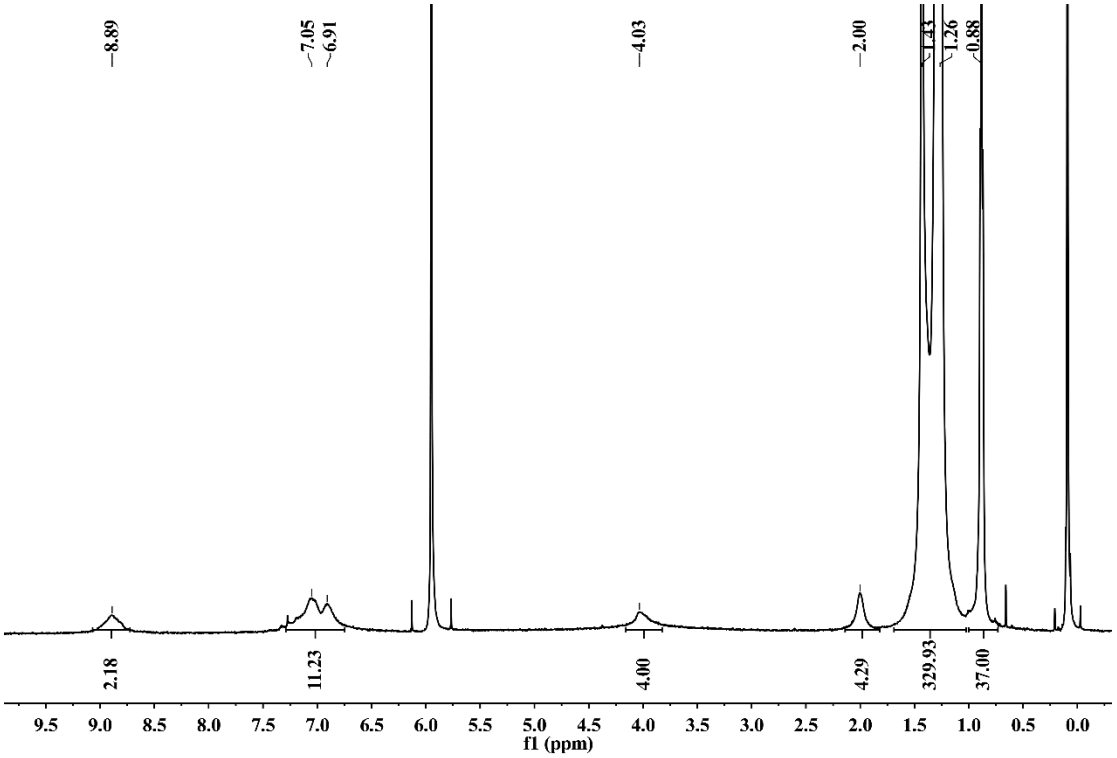


^{13}C NMR

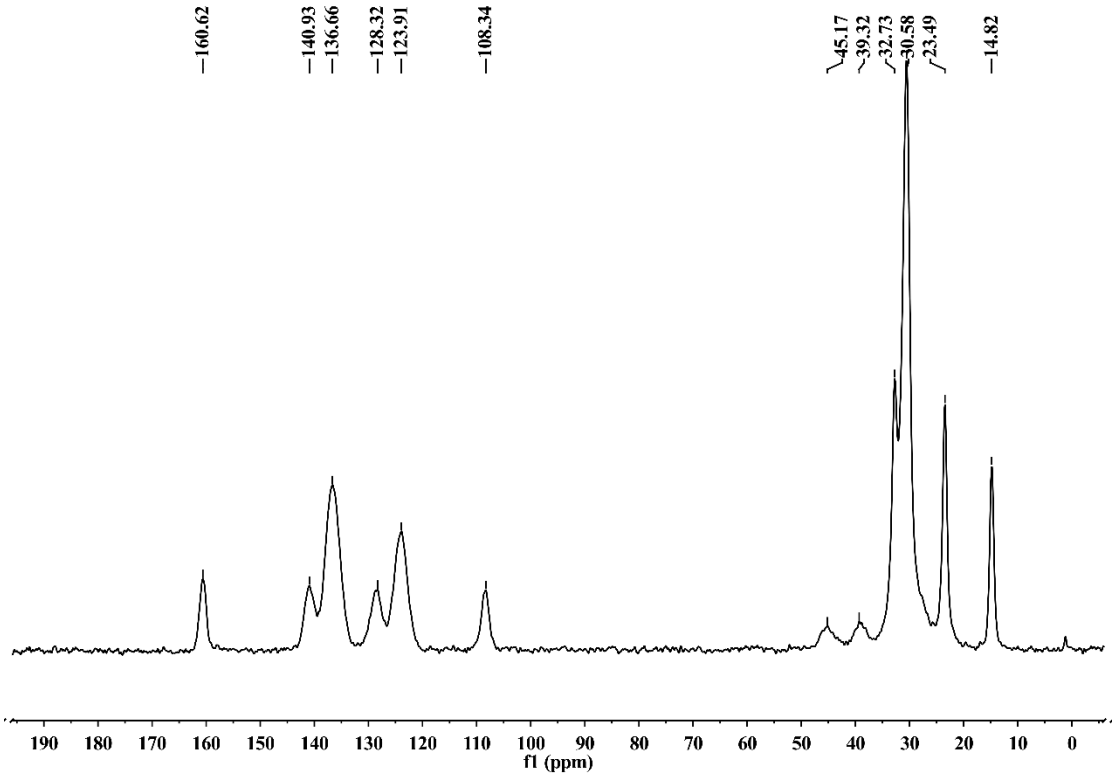


PDPP4T-2

^{1}H NMR

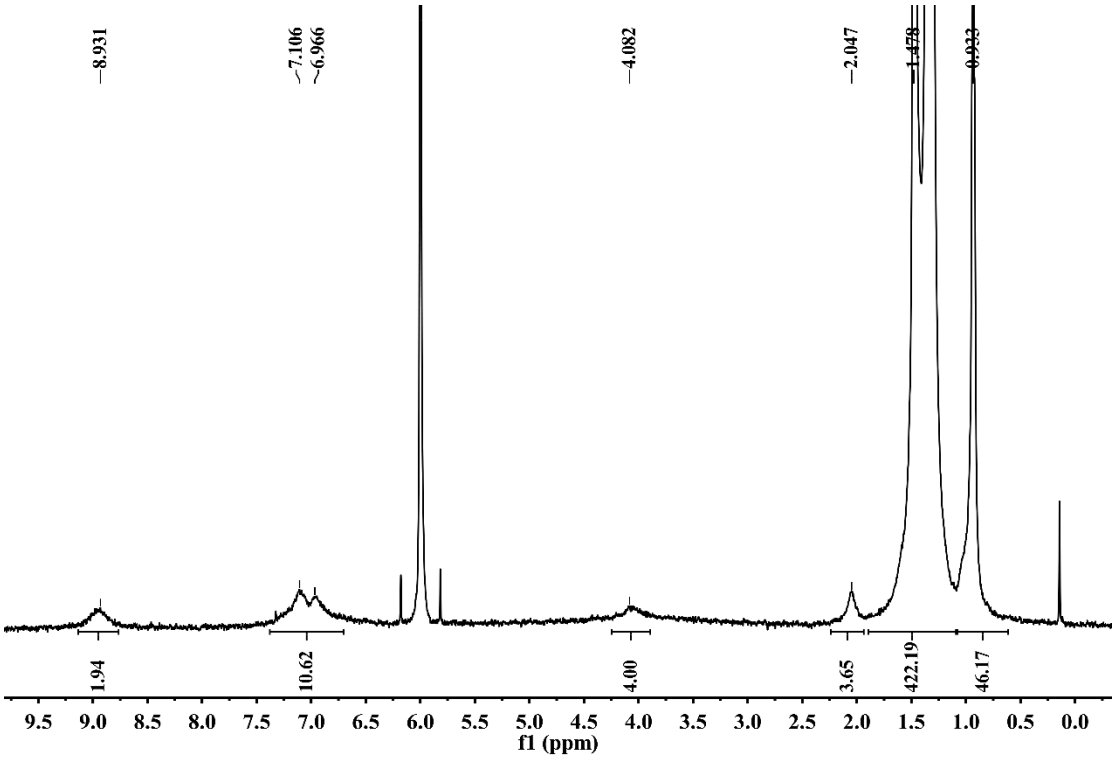


^{13}C NMR



PDPP4T-3

^{1}H NMR



^{13}C NMR