Electronic Supplementary Information (ESI)

Tuning Chain Extenders Structure to Prepare High-Performance Thermoplastic Polyurethane Elastomers

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1. Supplementary Table

Table S1 Comparison of thermal stabilities and mechanical properties of BDO-PU, monoFc-PU, and bisFc-PU.

Samples	$T_{5\%}$ (℃)	T_{max} (℃)	$\overline{E}_a$ (KJ/mol)	Young's modulus (MPa)	Stress, σ_{max} (MPa)	Strain, ε_{max} (%)	Toughness (GJ m^{-3})
BDO-PU	298	300	110.6	7.3	27.5	932	10.6
monoFc-PU	321	350	/	6.0	6.0	758	2.4
bisFc-PU	345	369	214.9	13.9	42.3	1018	19.6

2. Supplementary Figures

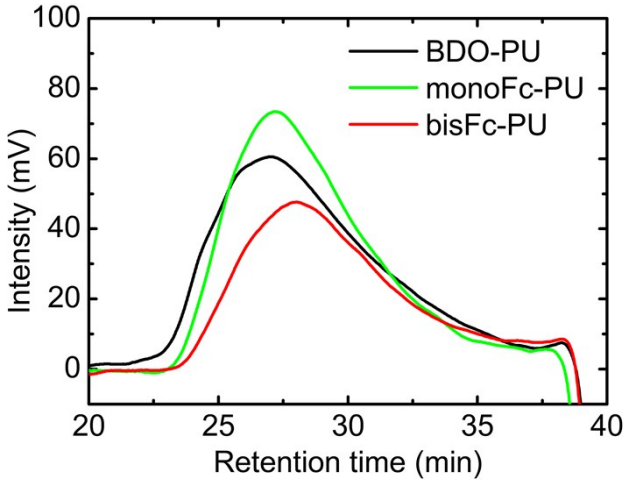

Fig. S1 Gel permeation chromatograph curves of BDO-PU, monoFc-PU and bisFc-PU were performed on a Waters-1515 using DMF-*LiBr* as an eluent and polystyrene (PS) as standards, the sample concentration was 2 ~ 3 mg mL^{-1}, and the flow rate was 0.800 mL min^{-1} at 40 °C. The BDO-PU (M_n = 3.6×10^4 g/mol, M_w/M_n = 2.0), monoFc-PU (M_n = 3.0×10^4 g/mol, M_w/M_n = 1.6), and bisFc-PU (M_n = 2.9×10^4 g/mol, M_w/M_n = 1.5).

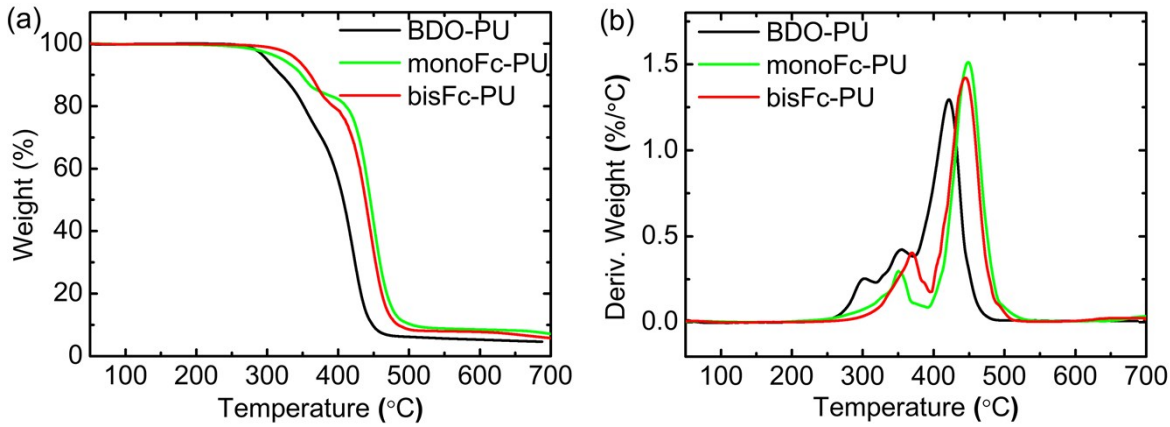

Fig. S2 (a) TGA and (b) DTG thermograms of- BDO-PU, monoFc-PU and bisFc-PU, at the heating rate of 10 °C min^{-1} from 50 to 700 °C under nitrogen atmosphere.

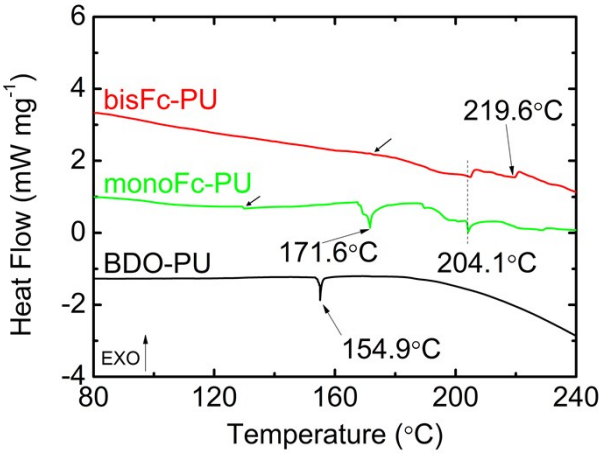

Fig. S3 The thermal behaviors of hard segments for BDO-PU, monoFc-PU and bisFc-PU. The curves were derived from differential scanning calorimeter (DSC) of the second heating processes between 80 to 240 °C.

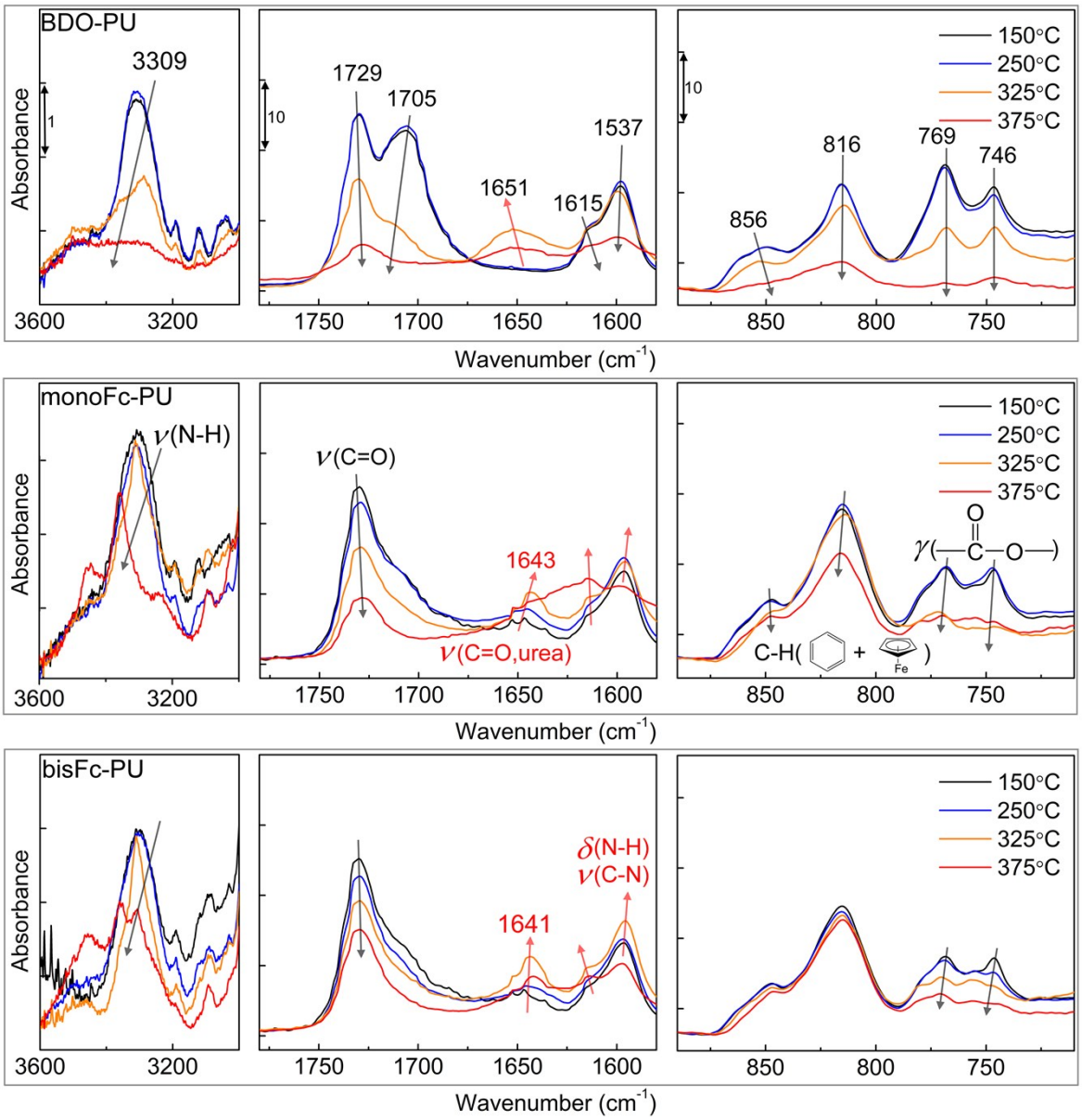

Fig. S4 Fourier transform attenuated total reflection infrared spectroscopy (ATR-FTIR) spectra at various temperature (150, 250, 325, 375 °C) of BDO-PU, monoFc-PU and bisFc-PU at the region of 3600 – 3000 cm^{-1}, 1780 - 1580 cm^{-1} and 890 - 700 cm^{-1}.

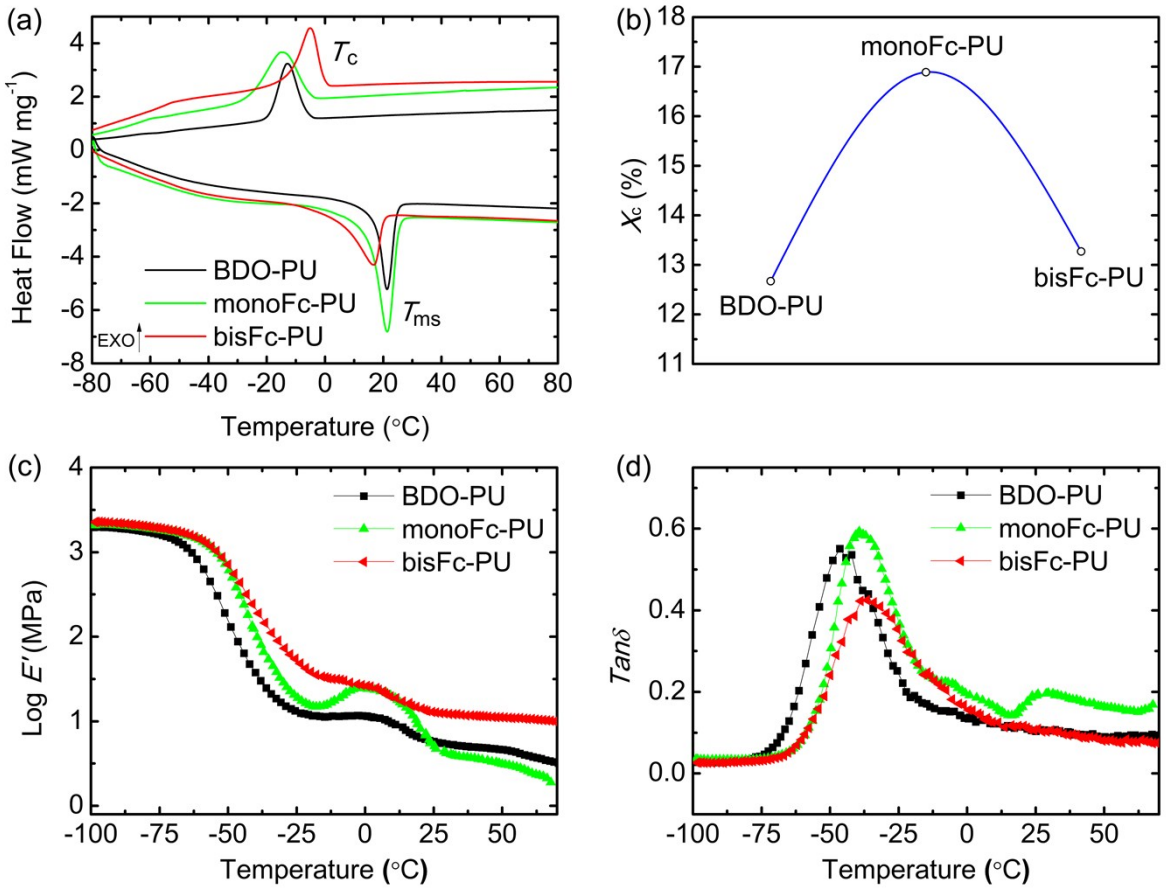

Fig. S5 (a) Differential scanning calorimeter (DSC) curves of first cooling and second heating processes and (b) The crystallinity (X_c) for BDO-PU, monoFc-PU and bisFc-PU; Dynamic mechanical analysis to show (c) the storage modulus and (d) *tan δ* of BDO-PU, monoFc-PU and bisFc-PU from at a heating rate at 3 °C min^{-1} from -100 to 80 °C. The degree of crystallinity (X_c) for those PUs were calculated via the equation of $X_c=\triangle H / \triangle H_0$, where $\triangle H$ is the heat fusion of PUs and $\triangle H_0$ is the enthalpy of fusion of the fully crystalline material of $\triangle H_0$= 172.2 J g^{-1}.[31]

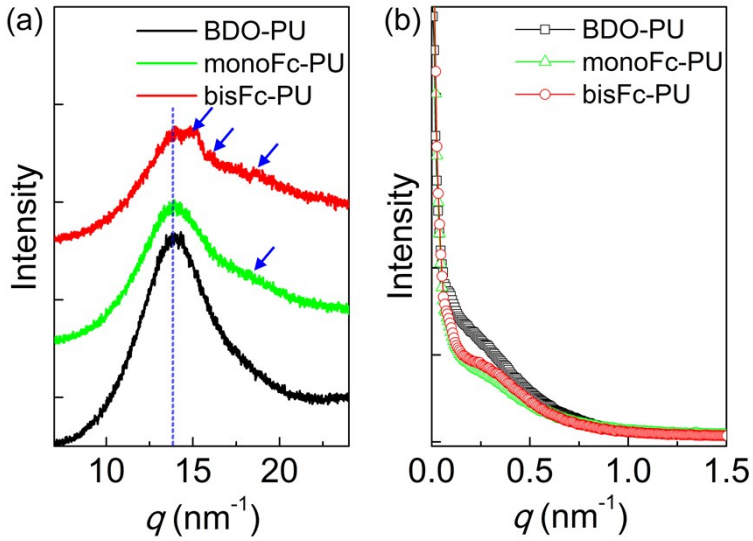

Fig. S6 (a) WAXD and (b) SAXS profiles of BDO-PU, monoFc-PU and bisFc-PU.

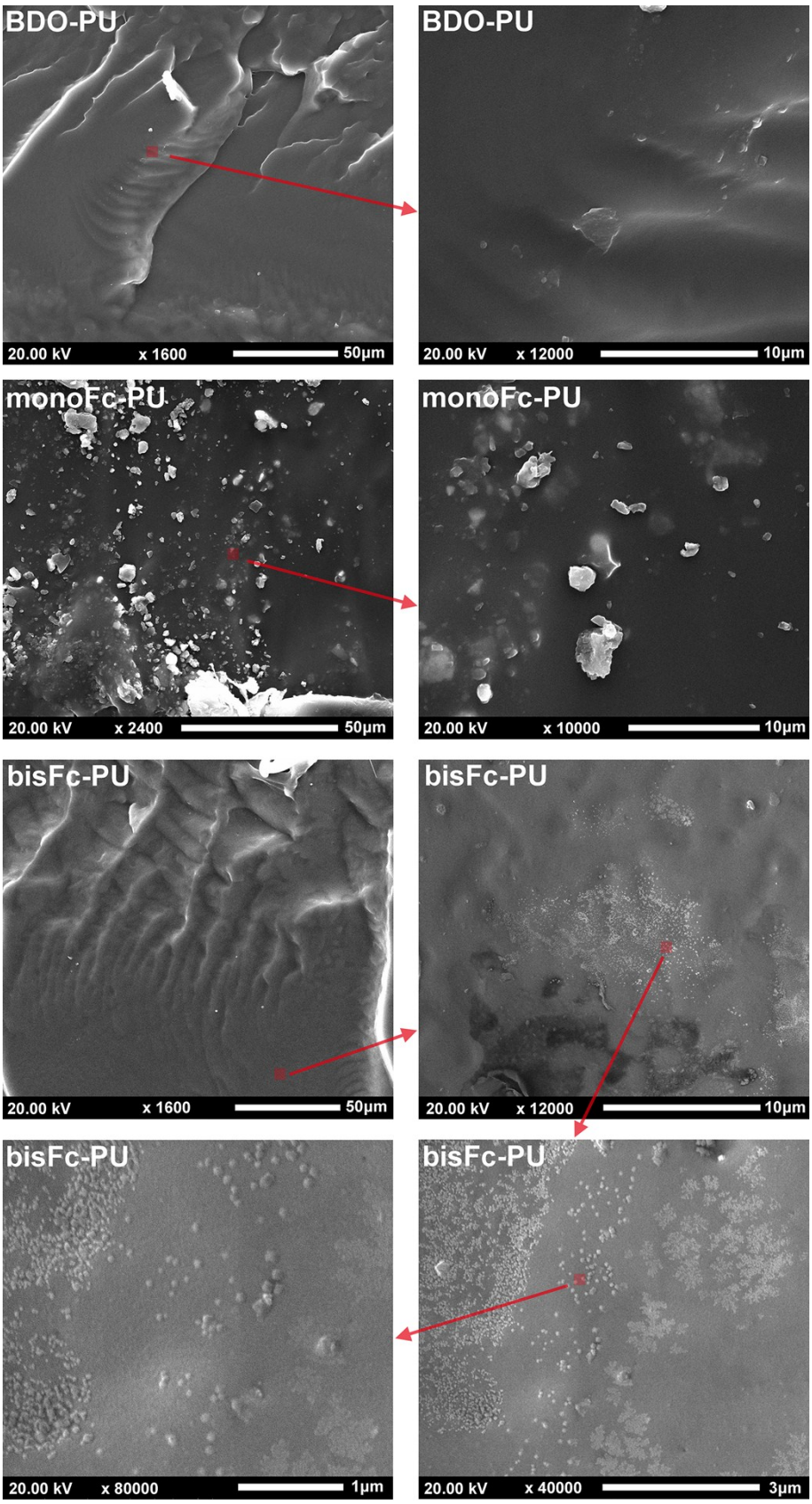

Fig. S7 SEM images of BDO-PU, monoFc-PU and bisFc-PU, and partial enlargements of the marked positions.

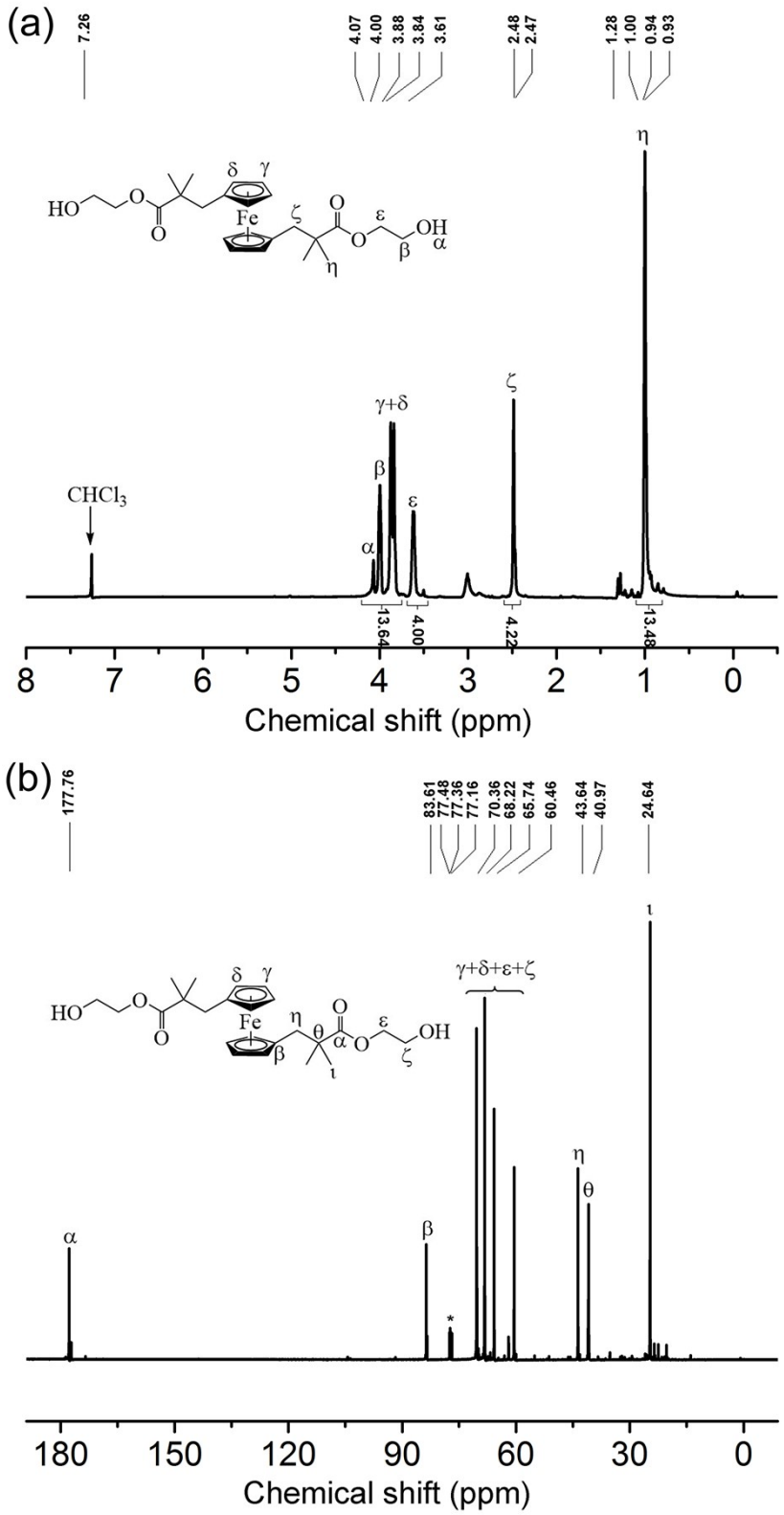

Fig. S8 (a) ^{1}H-NMR and (b) ^{13}C-NMR spectra for monoFc (600 Hz, $CDCl_3$).

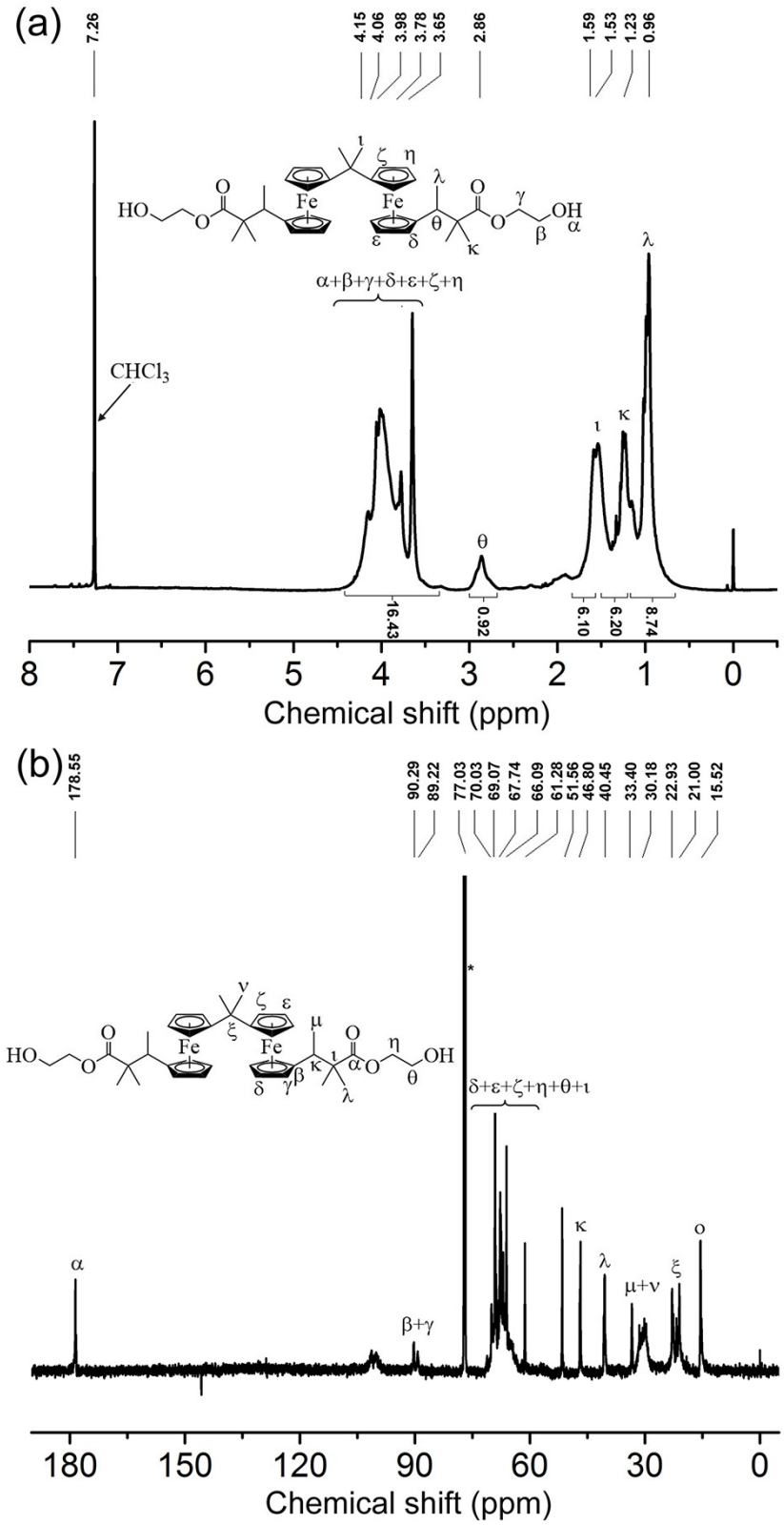

Fig. S9 (a) ^{1}H-NMR and (b) ^{13}C-NMR spectra for bisFc (600 Hz, $CDCl_3$).

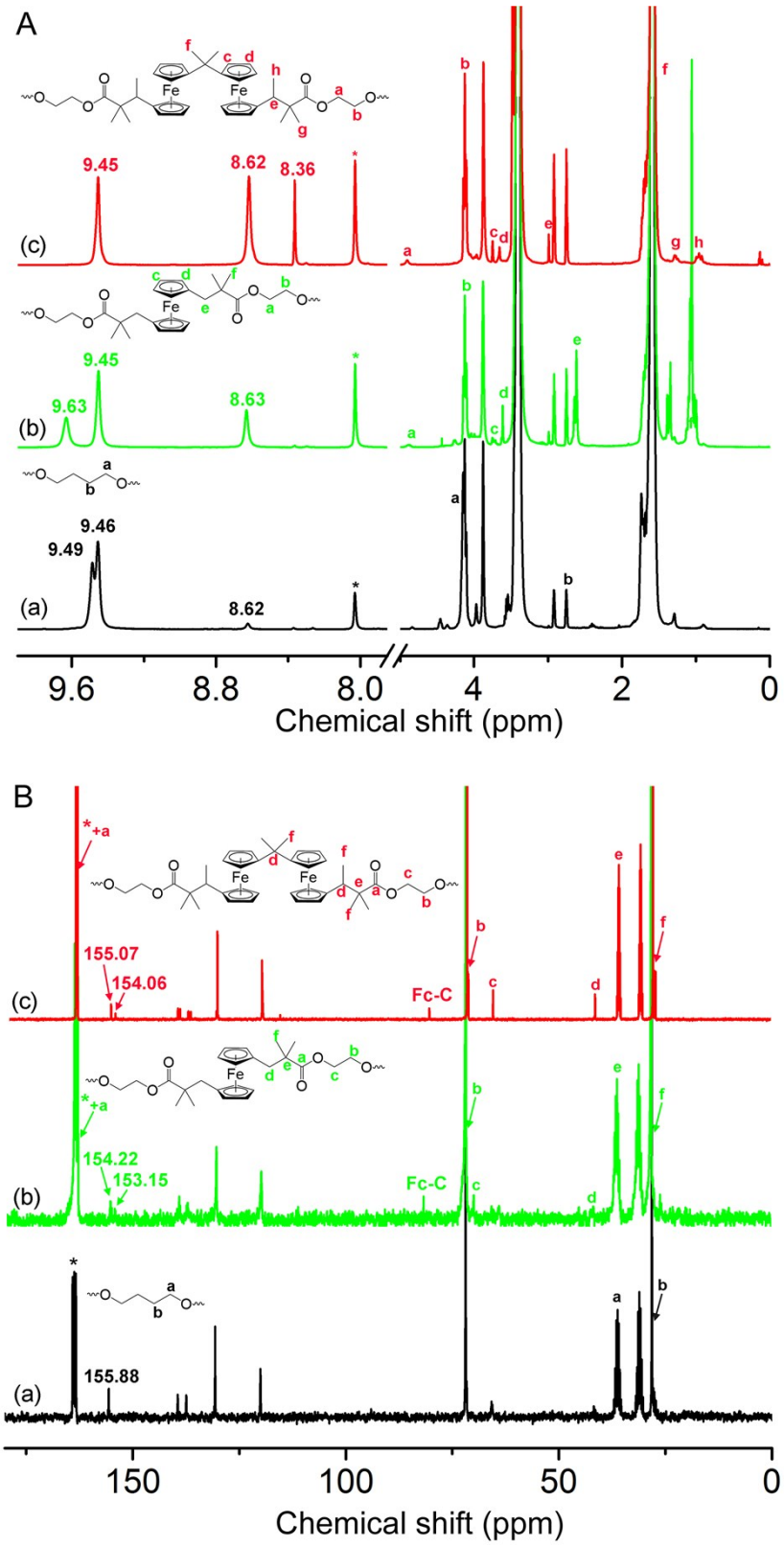

Fig. S10 A) ^{1}H-NMR and B) ^{13}C-NMR spectra for (a) BDO-PU, (b) monoFc-PU, and (c) bisFc-PU (600 Hz, DMF-d_7). (*) Signals of solvent.