Supporting information

A Supramolecular Polymer with Ultra-Stretchable, Notch- Insensitive, Rapid Self-Healing and Adhesive

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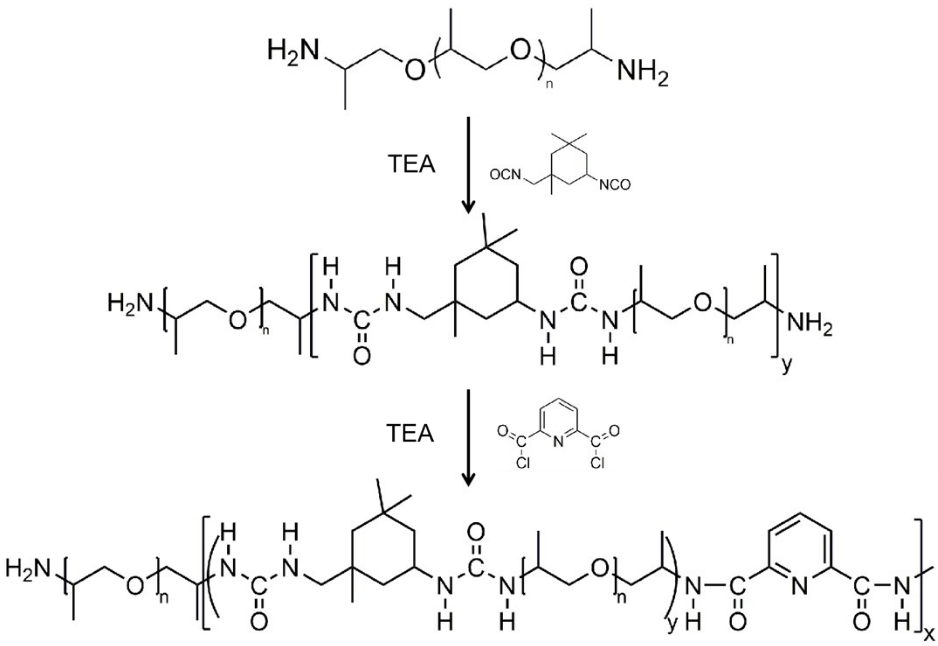


Figure S1. Schematic representation of the synthesis route of the copolymer network.

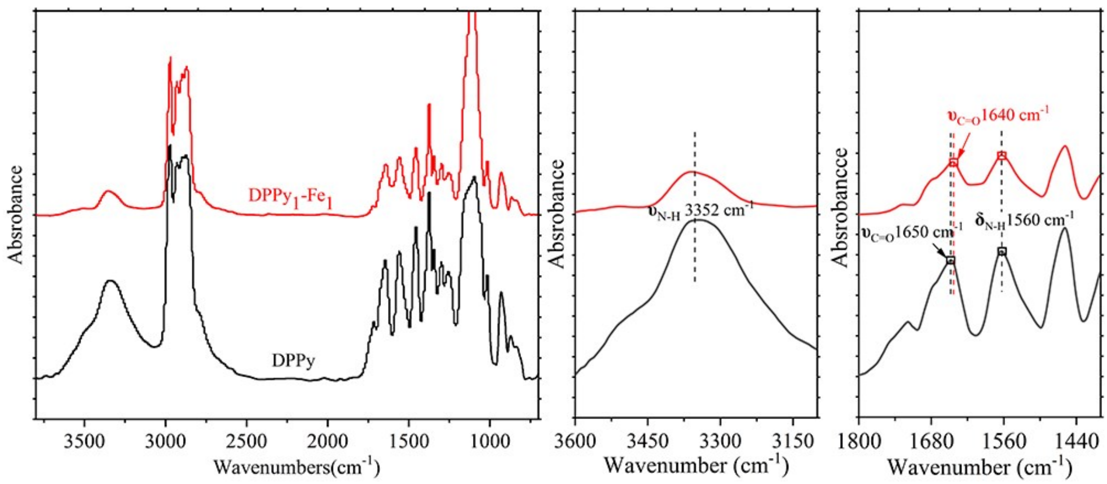


Figure S2. FTIR spectra of DPPy (black) and DPPy$_1$-Fe$_1$ (red) samples.

Table S1. Summaries of component settings for the metal-ligand polymers

Sample code	Molar Ratio of (Fe: Py)	The mass of ligand polymer (g)	The mass of $FeCl_3$-$6H_2O$ (mmol)
DPPy$_1$-Fe$_1$	1:1	2	0.185
DPPy$_2$-Fe$_1$	1:2	2	0.092
DPPy$_3$-Fe$_1$	1:3	2	0.063
DPPy$_1$-Fe$_2$	2:1	2	0.370

Table S2. The relative peak parameters of the GPC test.

Distribution of the name	Mn	Mw	Mp	Mz	Mz+1	Polydispersity index	Mz/Mw
DPPy	18176	41633	46220	62680	79633	2.29	1.92

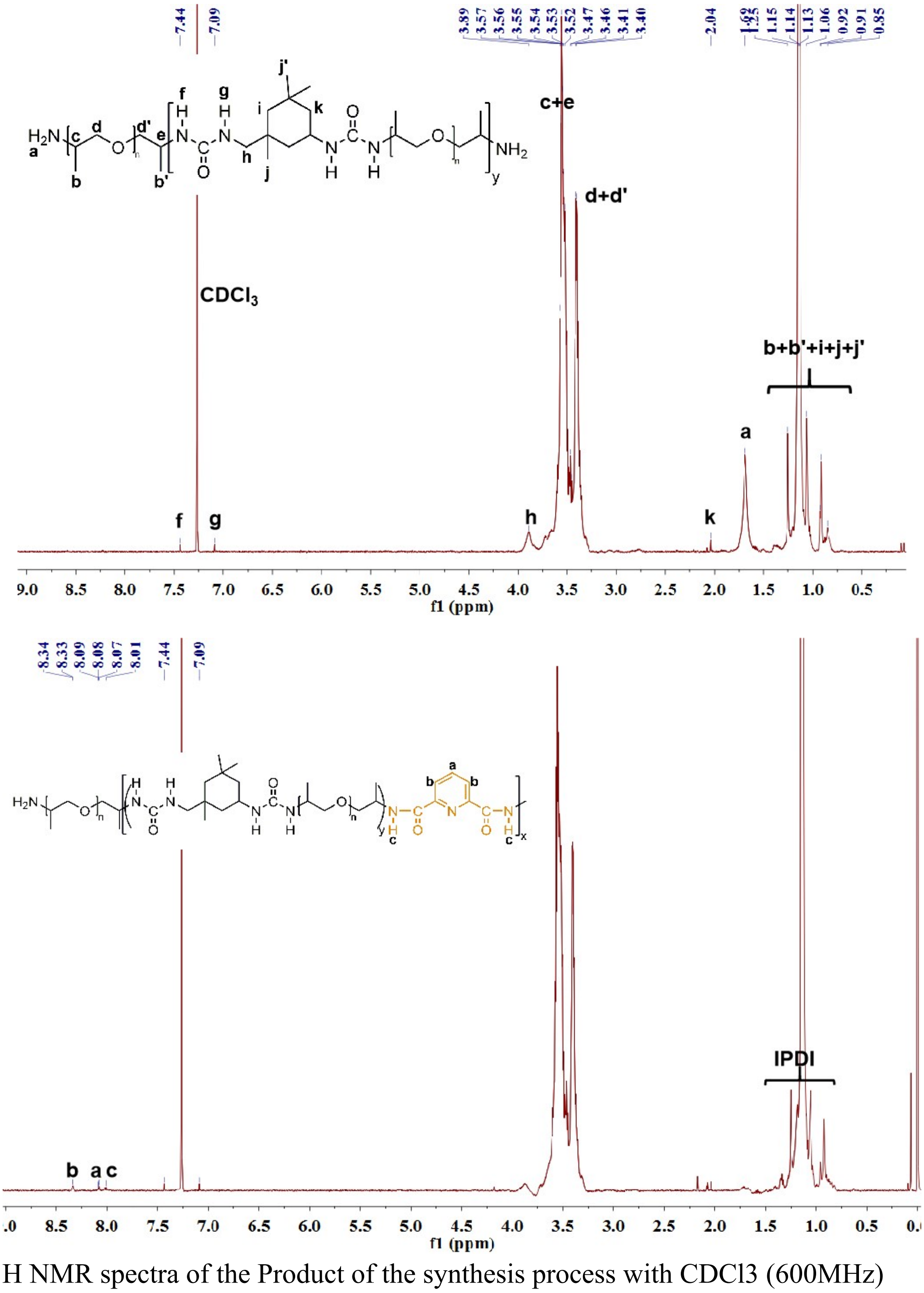
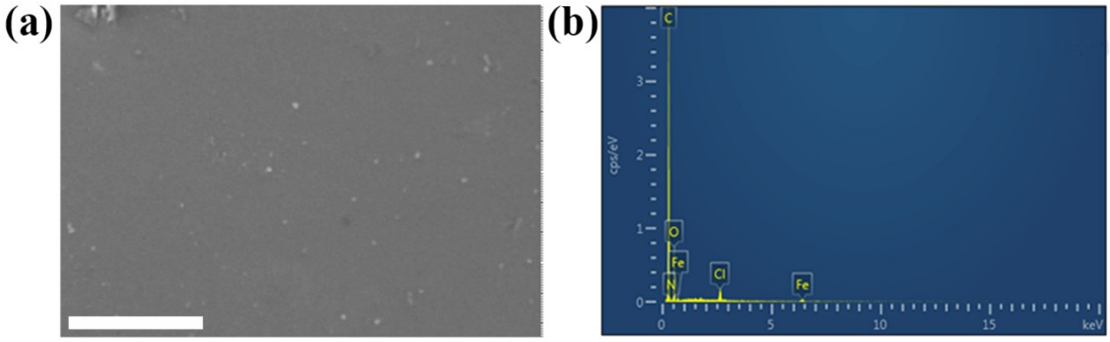


Figure S3. ^{1}H NMR spectra of the Product of the synthesis process with CDCl3 (600MHz)



(c)

Elemental	C	N	O	Cl	Fe	Summation
Wt%	67.74	1.41	28.56	1.32	0.97	100
Atoms percent	74.40	1.33	23.55	0.49	0.23	100

Figure S4. a) SEM image at the surface of $DPPy_1$-Fe_2 elastomer, and b) The corresponding elemental of C, N, O, Cl and Fe elements. c) Table of different element contents. The scale bar: 100 μm.

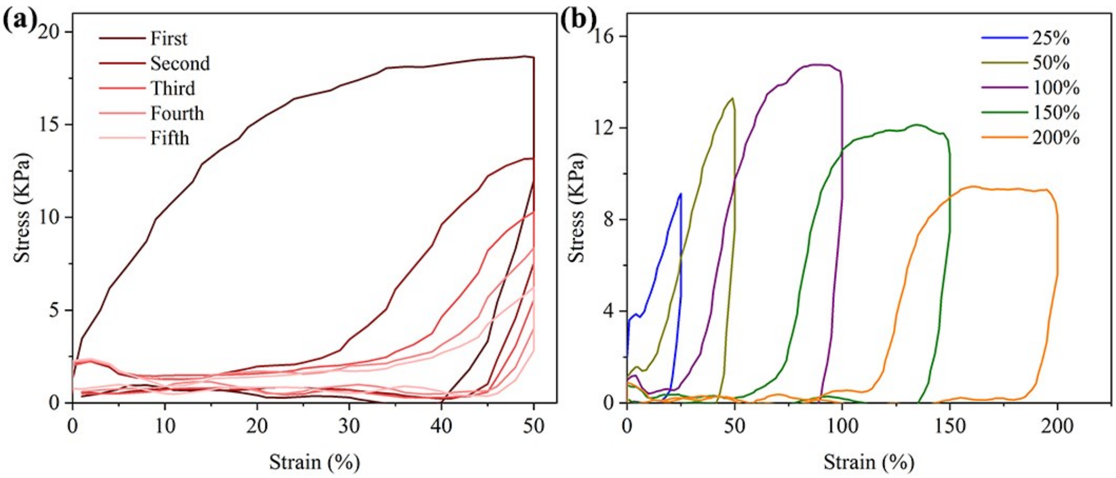


Figure S5. a) Recovery and cyclic loading of the rectangular spline $DPPy_1$-Fe_2. The samples were loaded (50% strain) and immediately released 5 times (tensile rate: 100 mm/min). b) Cyclic tensile test of the $DPPy_1$-Fe_2 at a settled stretch rate 100 mm/min, the sample was loaded to 25% strain firstly and then released to the original state (cycle 1). After that stretched to a higher strain (50%) immediately released the load which marked cycle 2. The cyclic test was repeated as the similar procedure gradually increased the strain with 100%, 150% and 200%.

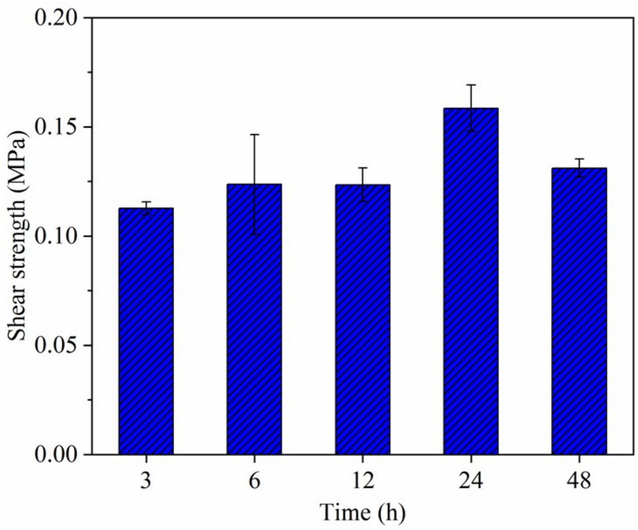


Figure S6. Shear strength versus adhesive time curves of the $DPPy_1$-Fe_2.

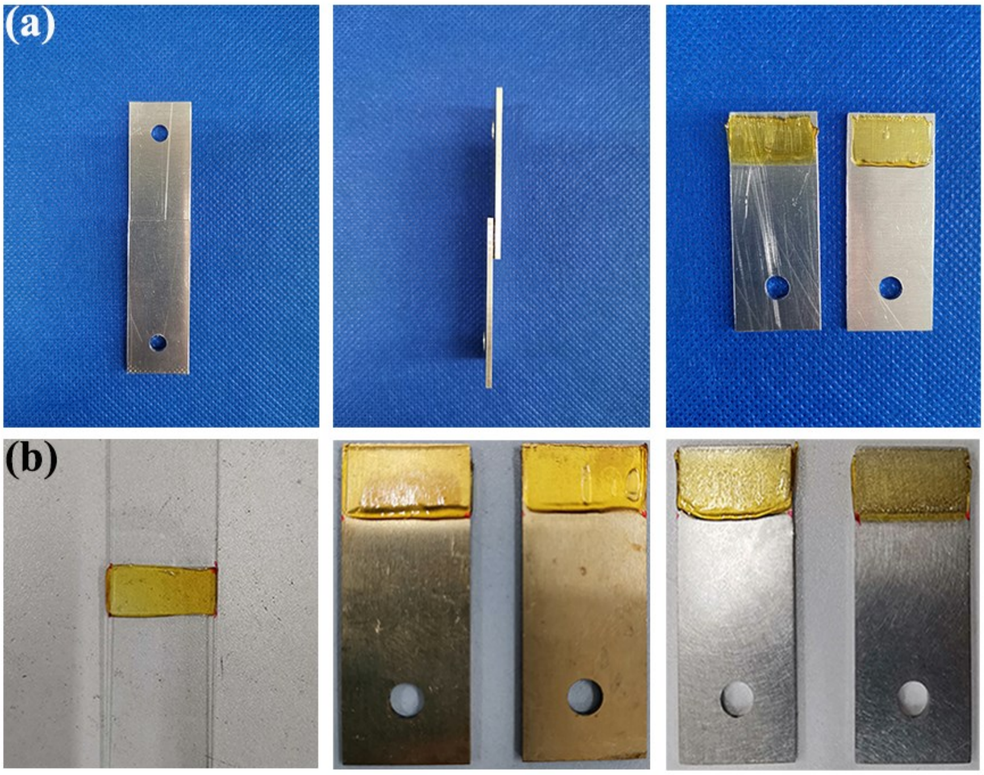


Figure S7. a) a piece of $DPPy_1$-Fe_2 film is used as adhesive agent between two aluminium alloy plates for 24h, The bonded aluminium alloy sheets were pulled apart via tensile machine. The glass substrates are put together and maintain in contact after pressing for about 24h. b) The picture of the split steel and copper plates by tensile machine.

Calculation of fracture energies

Fracture tests were conducted using the classical single-edge notch test on the Instron 5966 with a 1KN load cell. A notch of about 3.5 mm in length was made in the middle of a rectangular specimen of about 1.3 mm in thickness and about 7 mm in width. The specimen was fixed in two clamps with a pre-set distance of 15 mm. Then, the specimen was subjected to uniaxial tension with a strain rate of 100 mm/min. The fracture energy (G_c) was calculated by a method which introduces an empirical correction factor of:

$$G_{c=} 6Wc/\sqrt{\lambda_c} \qquad (1)$$

where c is the notch length; W is the strain energy calculated by integration of the stress-strain curve of an un-notched specimen until λ_c; the un-notched specimen underwent a tensioning process with the same strain rate as the notched sample.

Table S3. The comparation of relevant literatures.

Ref.	**Materials**	**Elongation (%)**	**Repairing efficiency (%)**	**Repairing time**	**Fracture energy (J/m^2)**	**Notch-insensitive elongation (%)**
1	Fe-Hpdca-PDMS	10000	90±2	48h	2571	<300
2	CSH-PPG-Zn-0.25	180000	100	3h	-	-
3	PPGTD-IDA	2010	100	48h	42650	>2000
4	SPMs	3100	88	48h	35596	~1200
5	“dry” elastomers	~170	30	12h	13500	small
6	PDMS-MPU$_x$-IU$_{1-x}$	~1800	84	48h	12000	1200
7	DT-IPDI$_x$-HMDI$_y$	2000	100	6 h	12500	769
8	MC hydrogels	3712	-	-	11700	3382
9	Hydrogels	2000	-	-	8700	1700
10	P(NaSS-co-MPTC)	540	-	-	4000	300
11	CB[8] host–guest complexes	2400	-	-	2100	700
	This work	4000	75	30 min	5000	3500

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