Support Information

A self-healing elastomer with outstanding mechanical properties designed based on urea bonds

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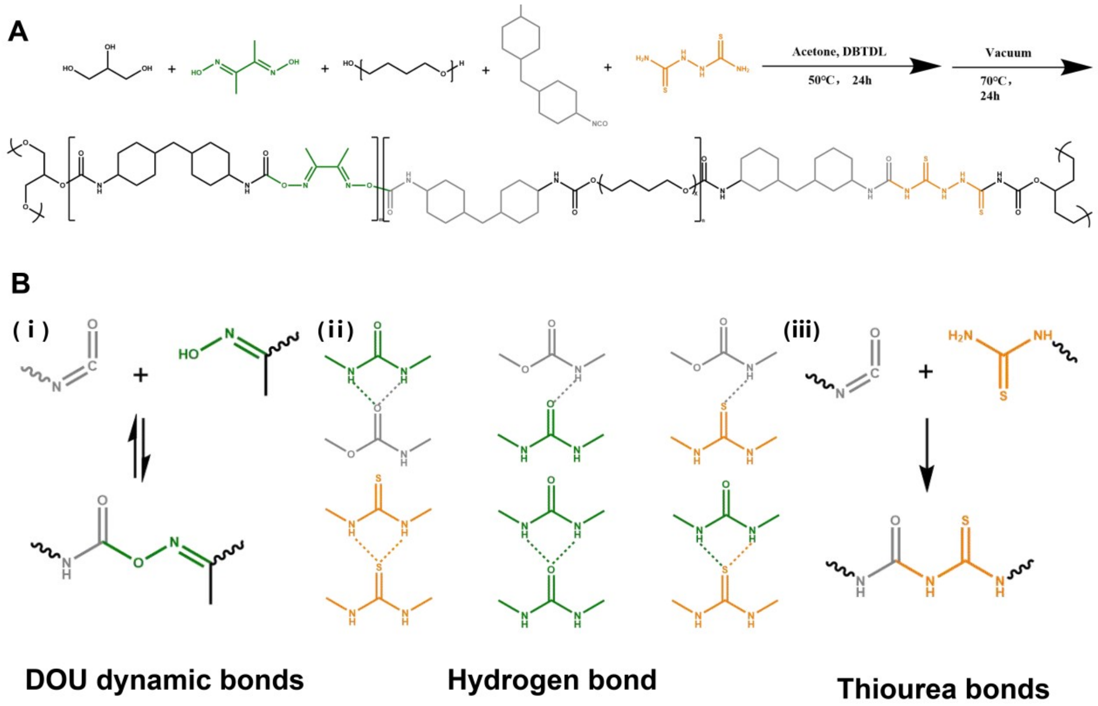

Figure S1 The route for the synthesis of DDPU.

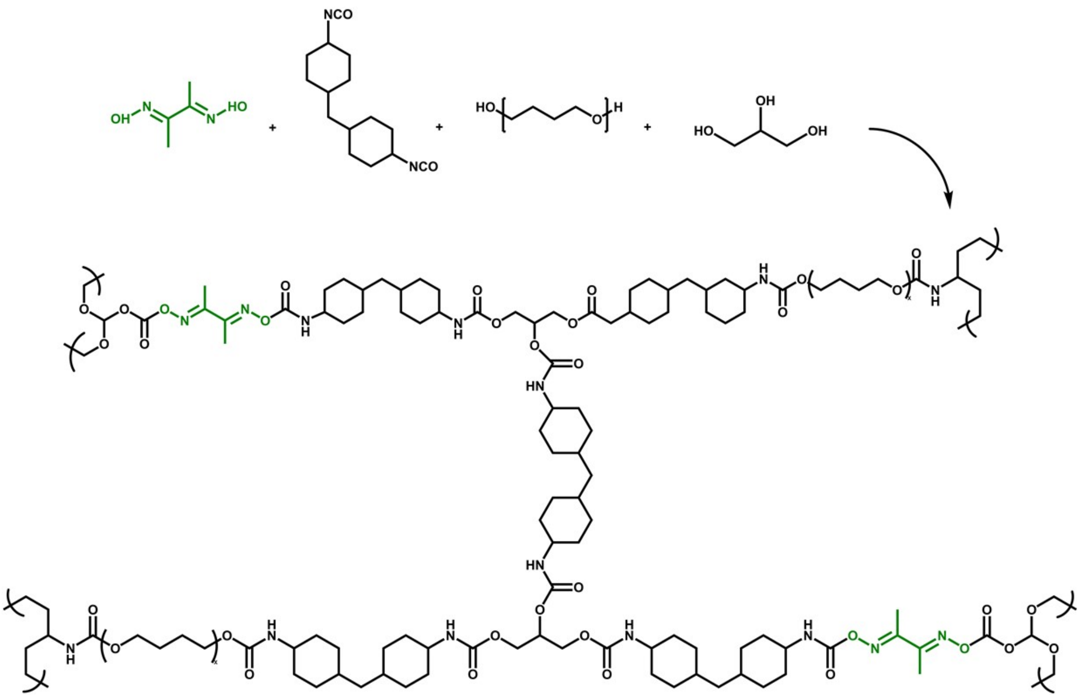

Figure S2 DOU-PU synthesis roadmap.

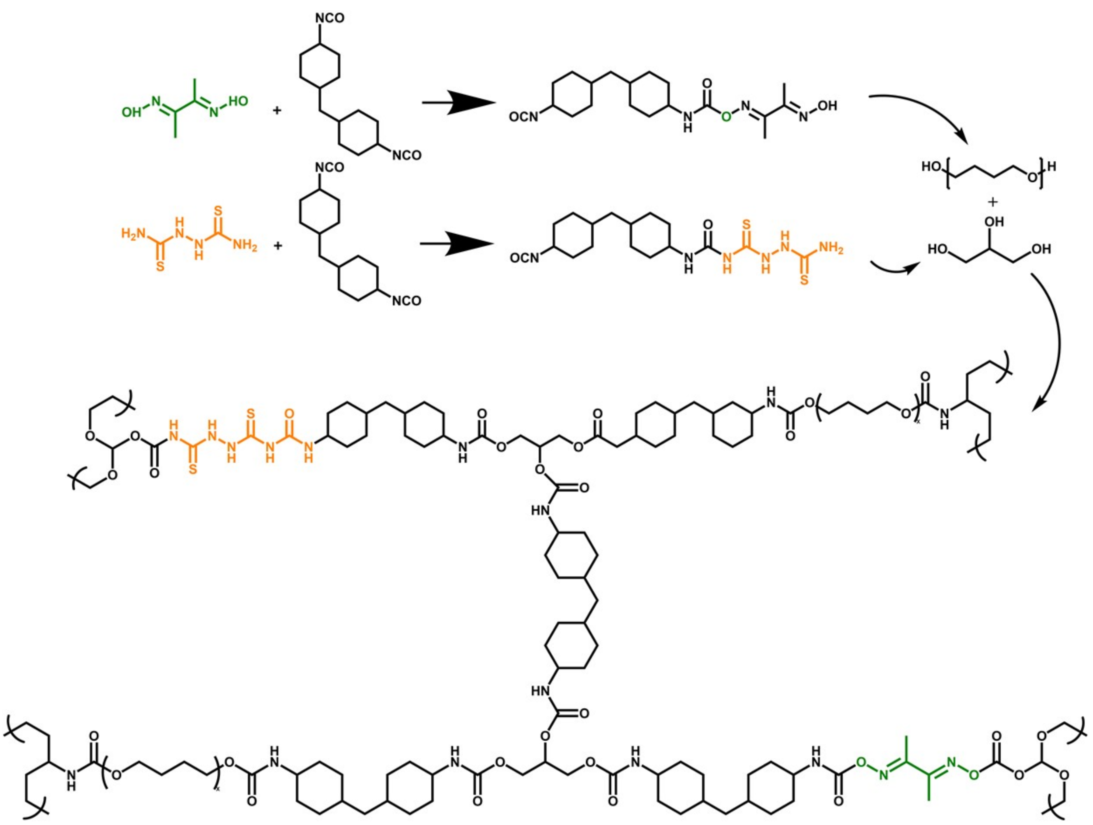

Figure S3 DDPU synthesis roadmap.

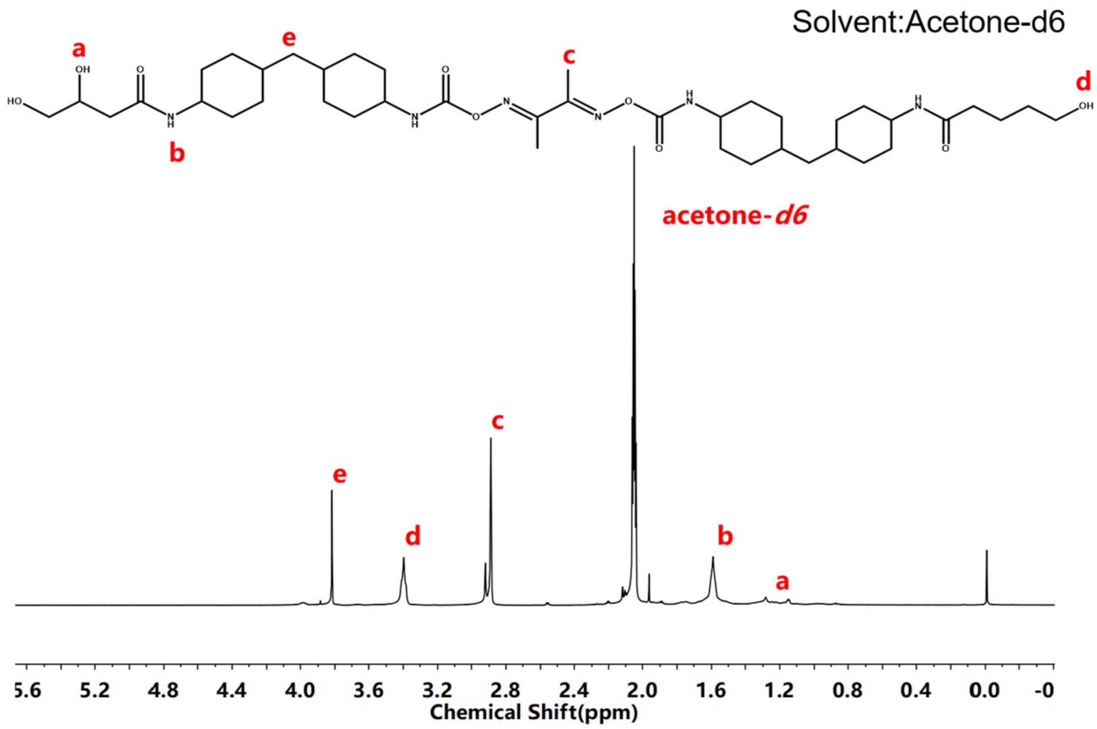

Figure S4 [1]H-NMR spectrum (400 MHz, Acetone-*d6*) of Br-thiolactone

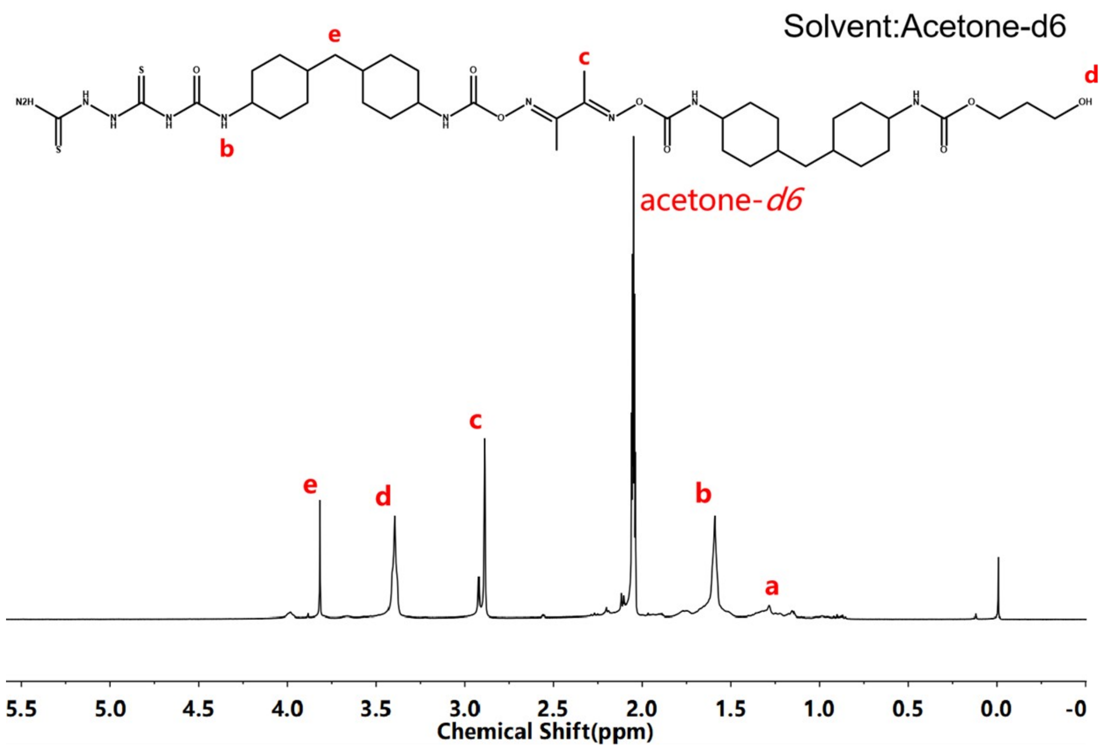

Figure S5 [1]H-NMR spectrum (400 MHz, Acetone-*d6*) of DDPU

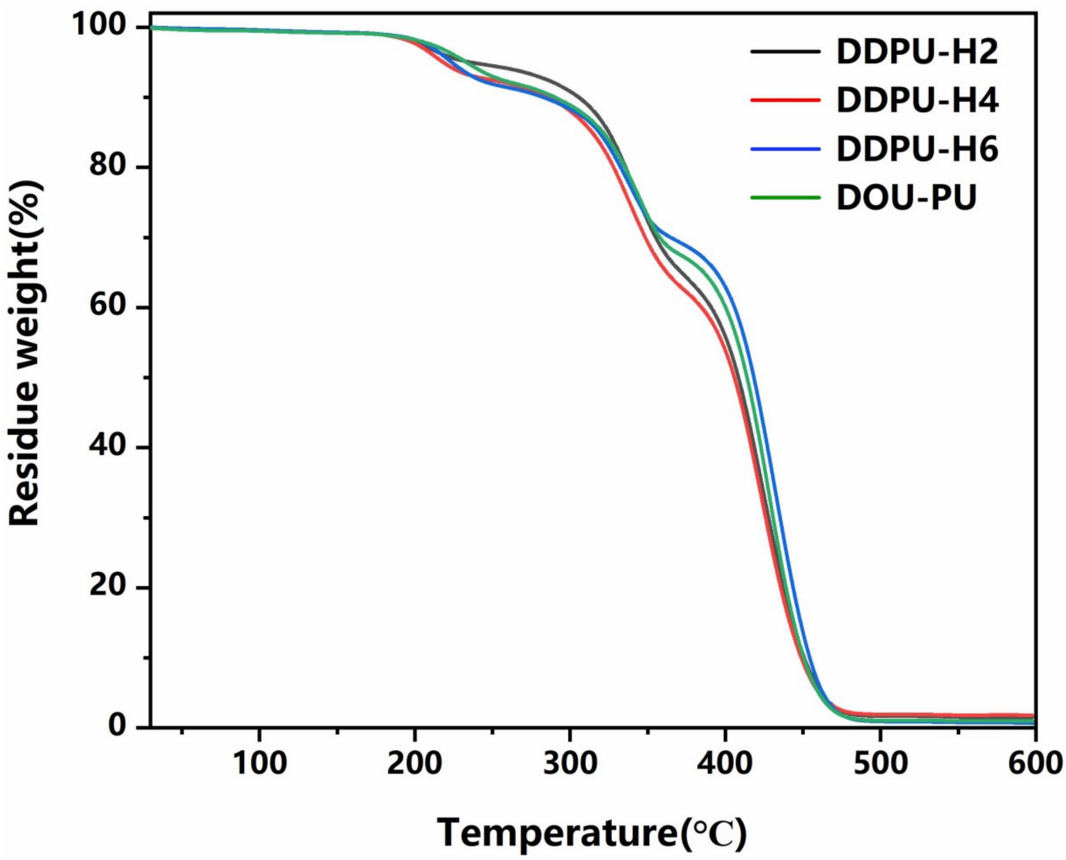

Figure S6 TGA curves of DDPU-H2, DDPU-H4, DDPU-H6 and DOU-PU elastomers

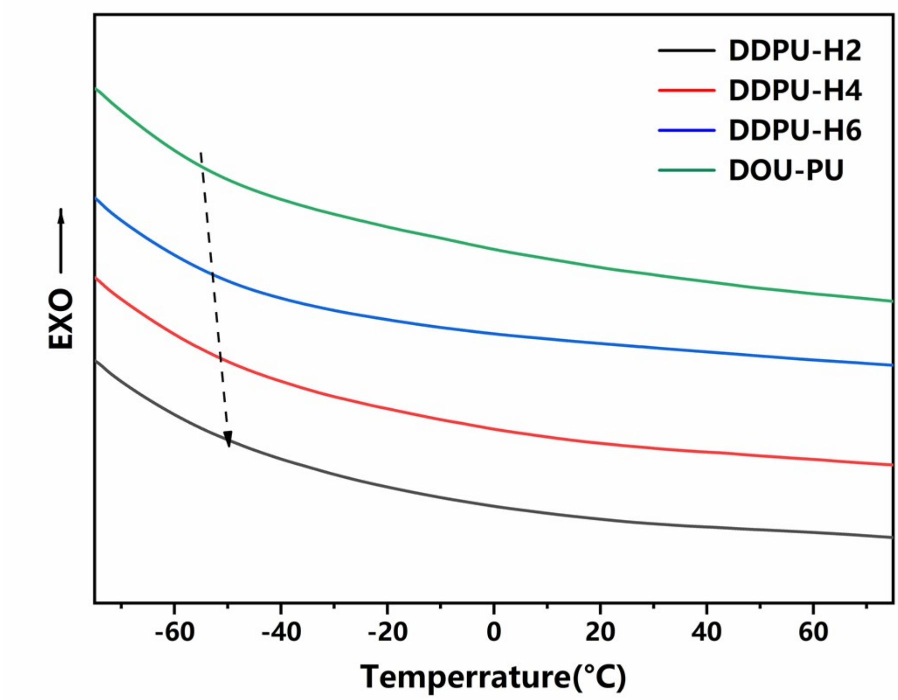

Figure S7 DSC curves of DDPU-H2, DDPU-H4, DDPU-H6 and DOU-PU elastomers

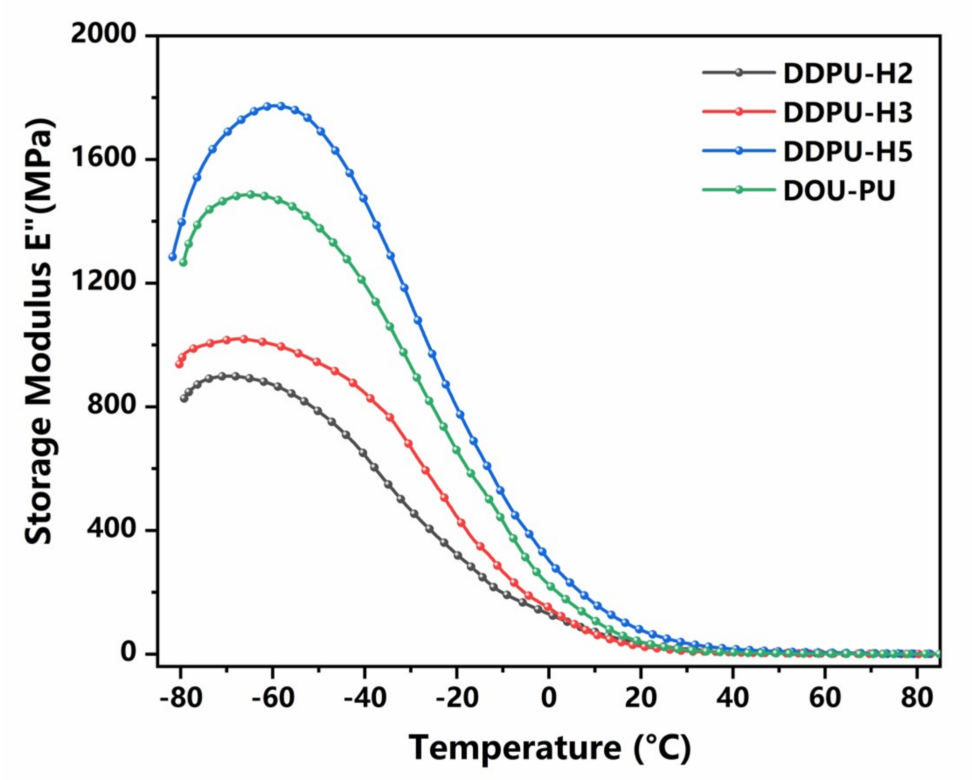

Figure S8 Variation of storage modulus (E') of DDPU and DOU-PU elastomers with temperature.

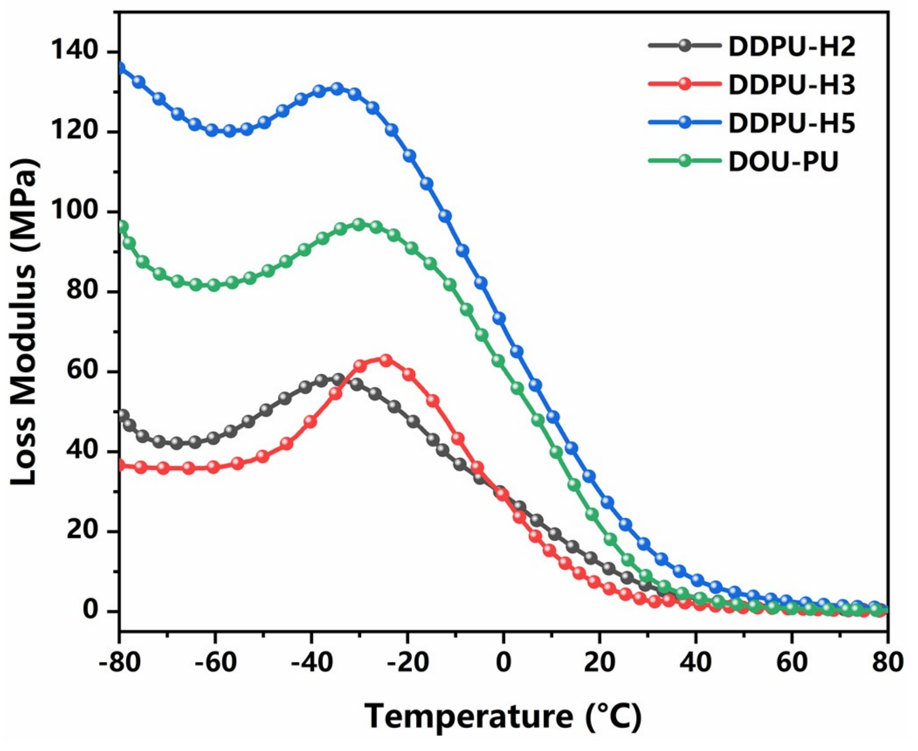

Figure S9 Variation of loss modulus (E") of DDPU and DOU-PU elastomers with temperature.

Table S1 Mechanical properties of DOU-PU, DDPU-H2, DDPU-H3 and DDPU-H4 elastomers

Sample	Breaking strength (MPa)	Toughness (MJ m^{-3})	Breaking elongation (%)
DOU-PU	7.17±0.36	32.52±3.1	1052.44
DDPU-H3	35.99±0.86	93.17±4.1	811.36
DDPU-H4	19.59±0.58	71.9±4.2	636.25
DDPU-H5	23.39±0.76	60.77±3.3	794.28
DDPU-H7	33.20±0.62	108.95±4.8	581.26

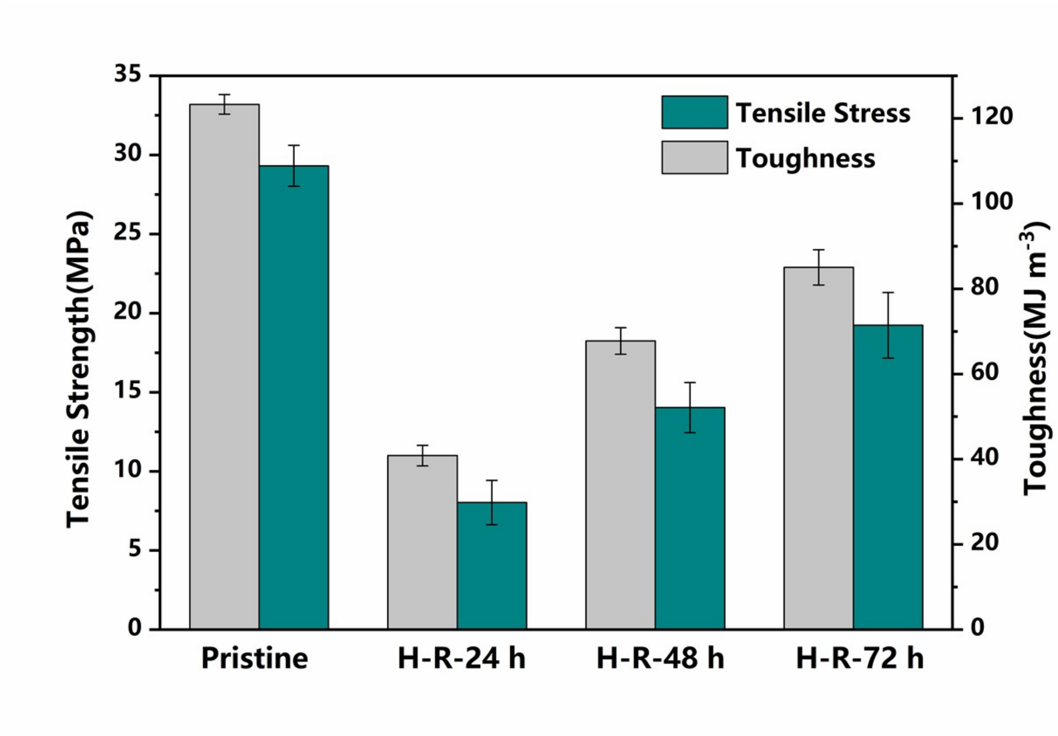

Figure S10 Tensile strength and toughness of DDPU elastomers healed for different times at room temperature.

Table S2 Mechanical properties of DDPU elastomer after healing at room temperature for different times.

Sample	Breaking strength (MPa)	Toughness (MJ m^{-3})	Breaking elongation (%)
DDPU-H4	33.20±0.6	108.95±4.8	581.26
H-R-24h	11.07±1.5	29.85±5.2	794.28

H-R-48h	18.25±1.9	52.14±6.6	636.25
H-R-72h	22.92±2.8	71.47±8.7	811.36

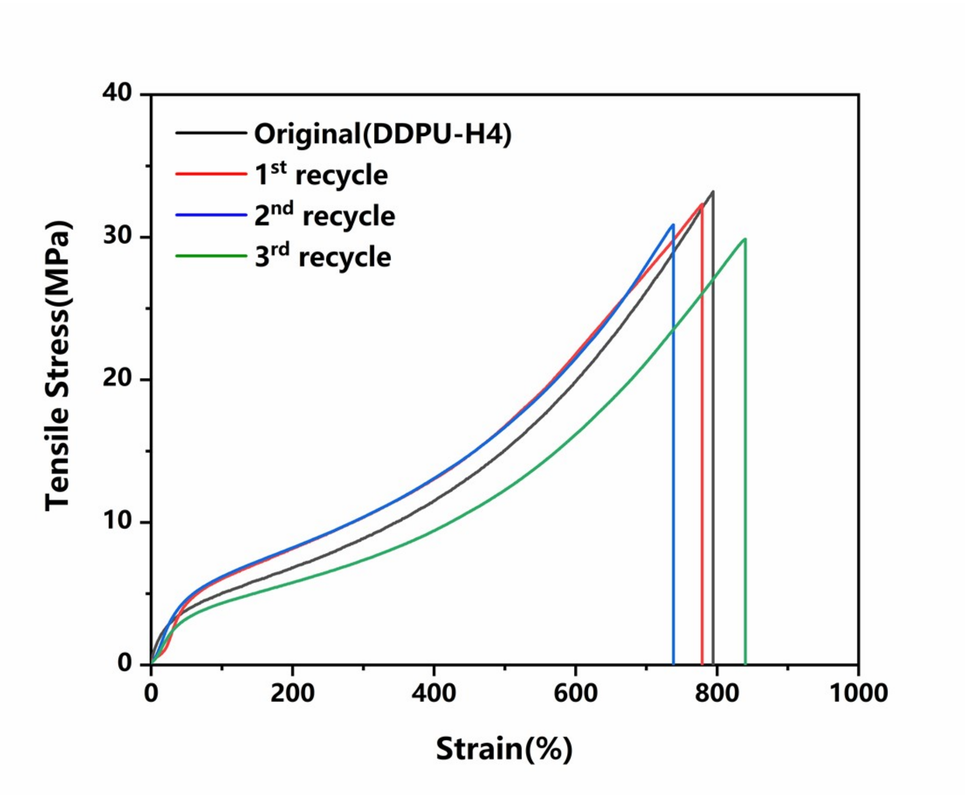

Figure S11 Stress-strain curve of DDPU-H4 elastomer recovered by hot pressing method.

Table S3 Mechanical properties of DDPU-H4 elastomer restored by hot pressing method.

Sample	Breaking strength (MPa)	Toughness (MJ m^{-3})	Breaking elongation (%)
Original	33.20	108.95	794.27
1^{st} recycle	32.33	113.89	778.90
2^{nd} recycle	30.88	101.88	738.20
3^{rd} recycle	29.87	102.06	839.85

Tensile mechanical properties were carried out on the AGS-X (Shimadzu) tensile machine (test speed: 100 mm min^{-1}, gauge length: 15 mm). The toughness is calculated using eq 1.[1, 2]

$$Toughness = \int_0^{\varepsilon fracture} \sigma d\varepsilon \qquad (1)$$

Here, ε represents the strain during the tensile test and σ represents the tensile stress.

The definition of self-healing efficiency (η) is based on the integral area under the stress-strain curve, which is calculated using the formula below.

$$\eta = \frac{\sigma_{healed}}{\sigma_{original}} \qquad (2)$$

In the formula, η —self-healing efficiency (%);

σ_{healed} —The toughness of the pattern after healing;

$\sigma_{original}$ —The toughness of original style.

Table S4 Reagent usage of DOU-PU and DDPU elastomers

	PTMEG	HMDI	Glycerol	DMG	DBTU	DBTDL
DOU-PU	1	0.622	0.023	0.116	0.000	0.02g
DDPU-H2	1	0.622	0.023	0.058	0.044	0.02g
DDPU-H3	1	0.622	0.023	0.070	0.035	0.02g
DDPU-H4	1	0.622	0.023	0.081	0.026	0.02g
DDPU-H5	1	0.622	0.023	0.093	0.018	0.02g
DDPU-H6	1	0.622	0.023	0.104	0.009	0.02g