Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Supporting Information

A Self-Healable, Stretchable, Tear-resistant and Sticky Elastomer Enabled by Facile Polymer Blends Strategy

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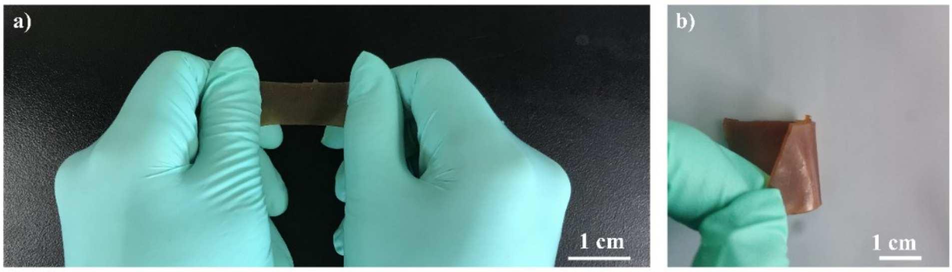

Fig. S1. a-b) Optical image of a BIIR-PαP film, which was obtained after the compressed blends.

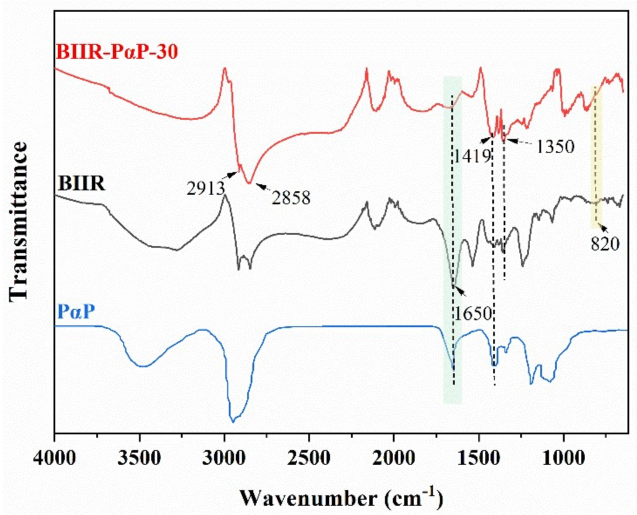

Fig. S2. FT-IR spectrum of the BIIR-PαP-30 composite, where the peaks correspond to -C-CH_3/-C-CH_2- stretching vibration at 2913 and 2885 cm^{-1},-CH_2- bending vibration at 1419 and 1350 cm^{-1}, respectively.

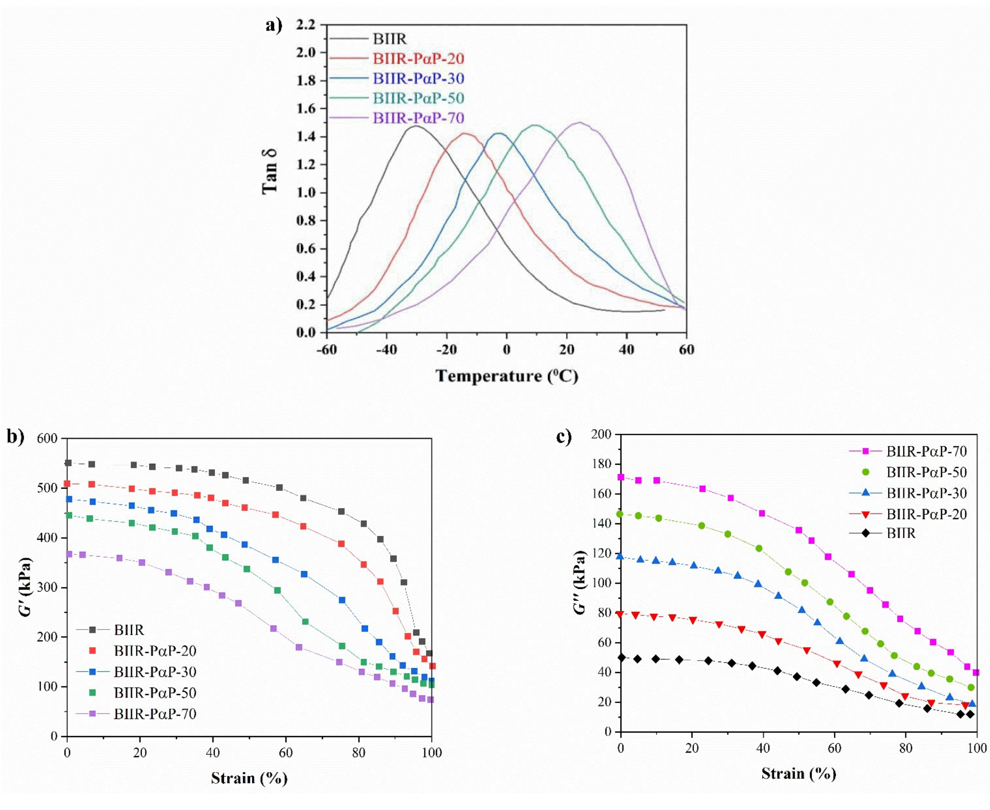

Fig. S3. a) Change of the loss factor (tan δ) with temperature of BIIR and BIIR-PαP composites. The relationship curve of strain between with dynamic properties of the unvulcanized rubber compounds: b) the storage modulus (G') and c) the loss modulus (G'') at 1Hz.

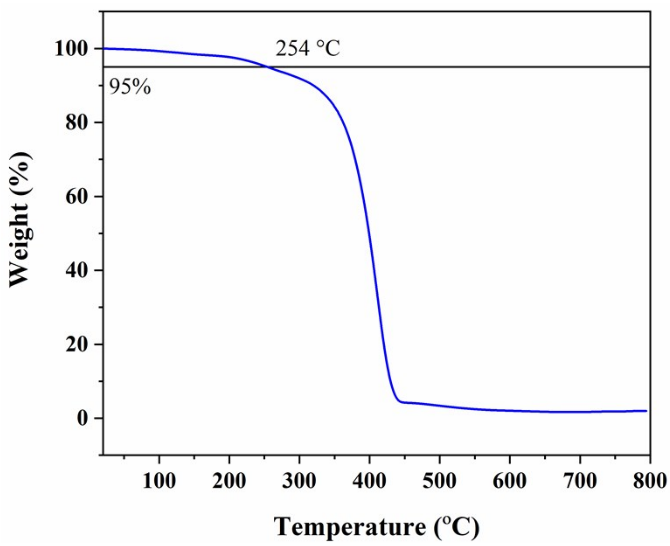

Fig. S4. TGA curve of BIIR-PαP-30 under nitrogen atmosphere at a heating speed of 10 °C/min.

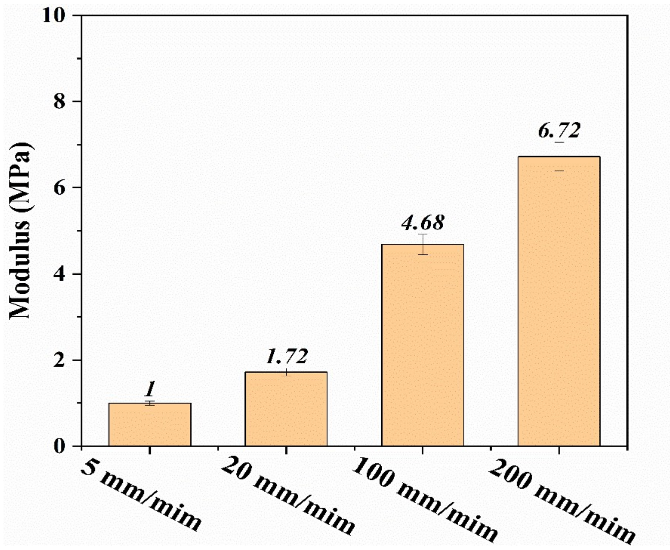

Fig. S5. Elastic modulus of BIIR-PαP-30 under different stretching rates.

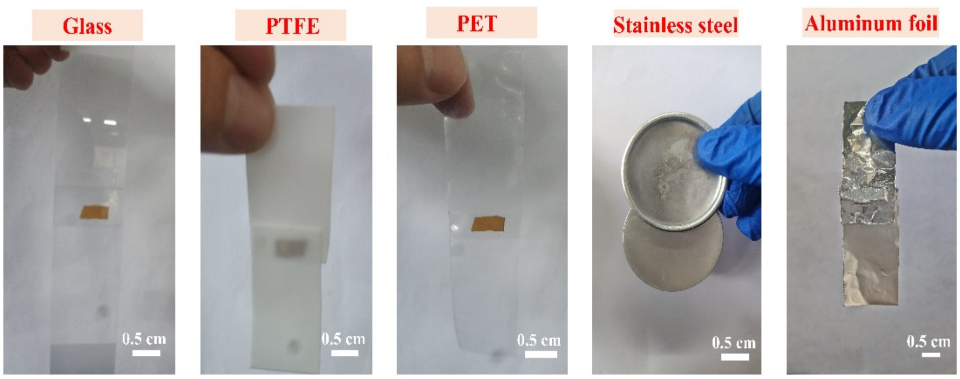

Fig. S6. Optical photos of a BIIR-PαP-30 film adhering to various representative substrates.

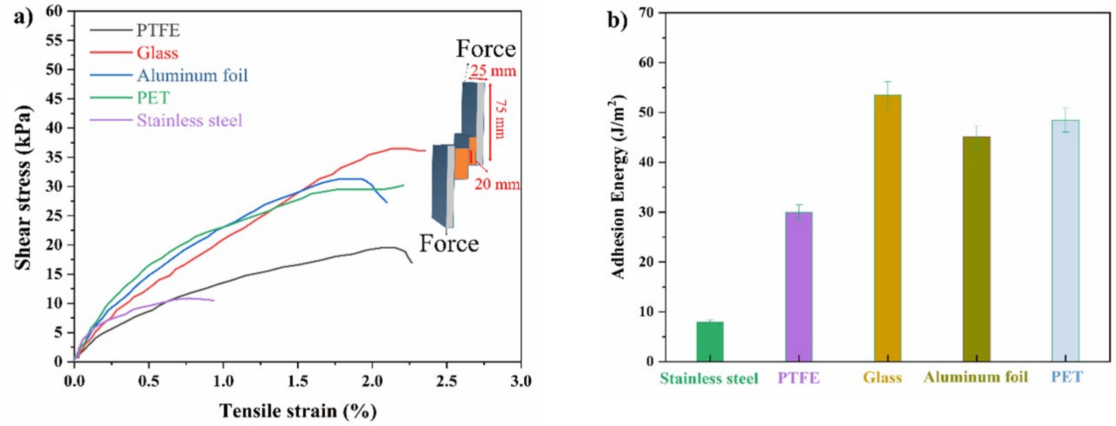

Fig. S7. a) Shear stress and b) adhesion energies of a BIIR-PαP-30 film adhering to a series of representative substrates.

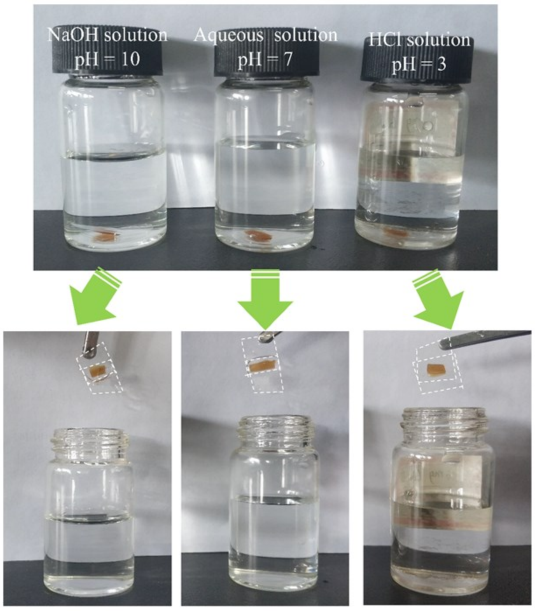

Fig. S8. Optical photos of a BIIR-PαP-30 film adhering to two pieces of glass, which were immersed in different pH solutions for 1d.

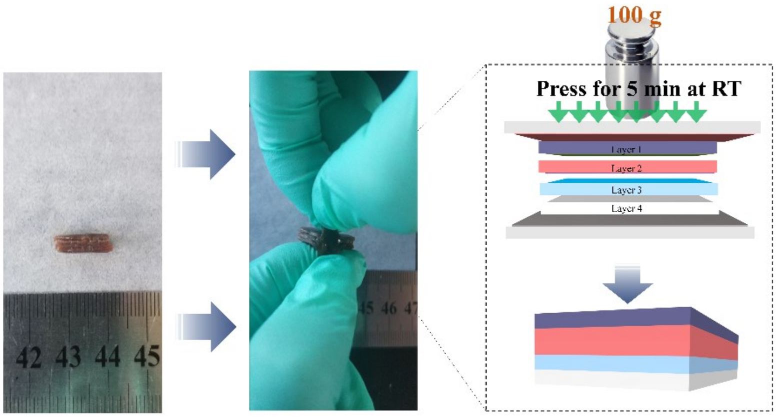

Fig. S9. Schematic diagram for separating of four pieces of BIIR-PαP-30 film after pressure (≈ 10 KPa, 100 g weight/1cm^2 sample surface) of 5 min at room temperature.

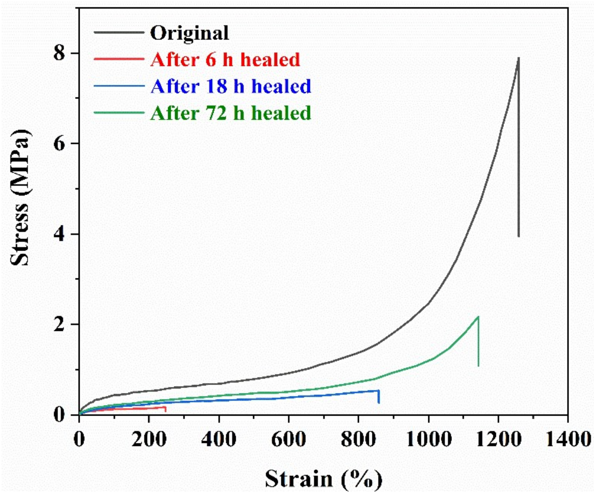

Fig. S10. Stress-strain curves of a BIIR-PαP-30 film healed at room temperature for different lengths of time.

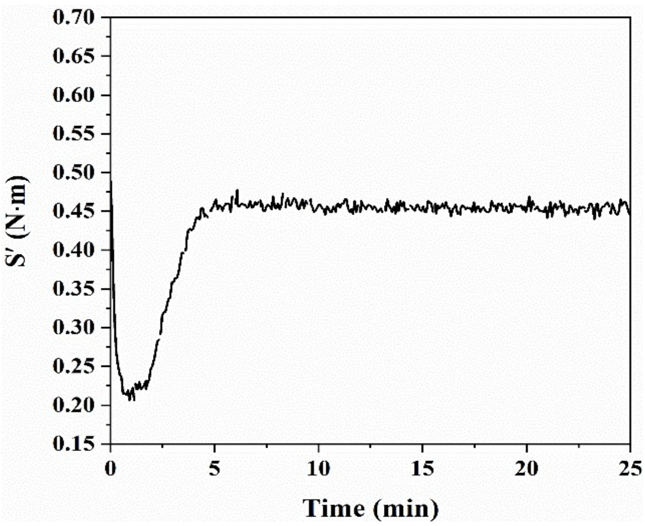

Fig. S11. The curing curve of the BIIR-PαP-30 composite.

Table S1. Summary of the mechanical properties of the various BIIR-PαP composites measured at a stretching speed of 20 mm min^{-1}.

Samples	Weight ratio of BIIR and PαP	Ultimate tensile strength (MPa)	Elongation at break (%)	Toughness (MJ/m^3)
BIIR- PαP-20	80:20	11.5±1.1	980±23	21.3
BIIR- PαP-30	70:30	7.9±0.7	1257±48	21.5
BIIR- PαP-50	50:50	5.0±0.4	1716±71	20.5
BIIR- PαP-70	30:70	3.7±0.2	1350±50	8.1

Table S2. The comparison of tensile strength, elongation at break, toughness and self-healing time of various self-healing polymers at room temperature.

Samples	Tensile strength (MPa)	Elongation at break (%)	Toughness (MJ/m^3)	Self-healing efficiency over 80% (h)	Ref
Polybutadiene	0.4	100	0.25	1[a]	1
Polyurethane	1.6	620	4.5	24	2
Boronic ester network materials	4	53	1.2	72	3
Polyacrylic acid (PAA)/polyvinylpyrrolidone (PVPON)	~80	~2.5	NA	11[b]	4
Poly(ethylene oxide)/pluronic F127 Hydrogel	0.25	10650	10.7	24	5
Disulfide bonds based polymers	0.21	100	0.12	24	6
Bromobutyl rubber/terpene resin composites	3.8	1156	12.2	72	Our work
	6.0	1200	16.67	0.5[c]	

[a] Self-healed under a pressure of 20 kPa; [b] Self-healed under immersion in water; [c] Self-healed under pressure (≈10 kPa).

Table S3. Vulcanization parameters and crosslinking density of BIIR- PαP with different sulfur and PαP content.

Samples	Scorch time (s)	Optimum cure time (s)	Minimum torque (dN·m)	Maximum torque (dN·m)	Crosslinking density (10^{-4} mol/cm^3)
BIIR- PαP-20	254	1020	0.35	0.65	1.843
BIIR- PαP-20(1.5)	206	932	0.52	0.84	1.911
BIIR- PαP-30	293	1207	0.21	0.45	1.792

Table S4. Curing formula of BIIR-PαP composites.

Samples	BIIR (phr)	PαP (phr)	ZnO (phr)	S (phr)	SA[a] (phr)	DM[b] (phr)	TMTD[c] (phr)
BIIR- PαP-20	80	20	3	1	1	0.75	0.25
BIIR- PαP-30	70	30	3	1	1	0.75	0.25
BIIR- PαP-50	50	50	3	1	1	0.75	0.25
BIIR- PαP-70	30	70	3	1	1	0.75	0.25

a) Stearic acid; b) 2, 2'-dithiodibenzothiazole; c) Tetramethyl thiuram disulfide.

References

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