Supporting Information

Flexible, stretchable and wearable strain sensor based on physical eutectogels for deep learning-assisted motion identification

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Table S1. The composition of DESL eutectogels.

Sample	Lignin	DES	Water	Photo-initiator
	g	g	g	μL
DESL-0.0%	0.000	10.0	1.0	20
DESL-0.2%	0.020	10.0	1.0	20
DESL-0.4%	0.040	10.0	1.0	20
DESL-0.6%	0.060	10.0	1.0	20
DESL-0.8%	0.080	10.0	1.0	20
DESL-1.0%	0.100	10.0	1.0	20

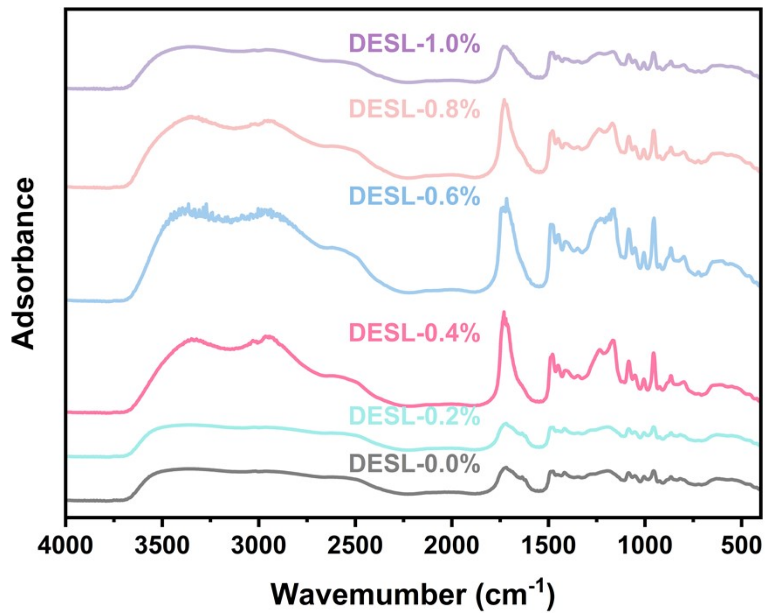

Fig. S1. The FT-IR spectra of DESL eutectogels with different lignin content.

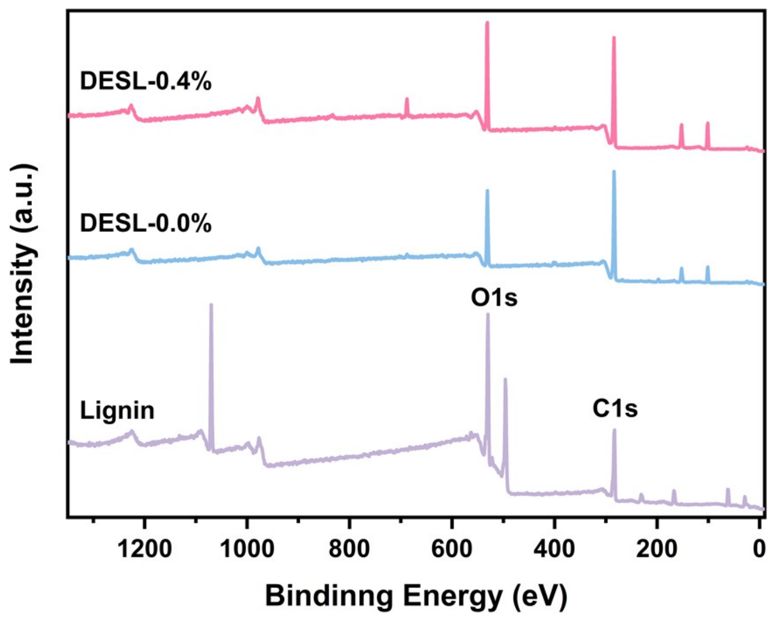

Fig. S2. XPS spectra of lignin, DESL-0.0% and DESL-0.4% eutectogels.

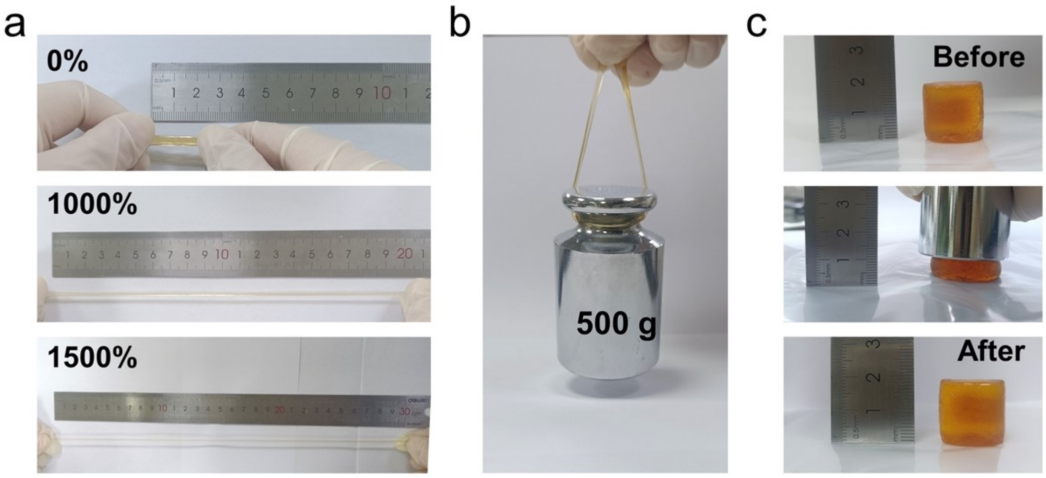

Fig. S3. Photographs displaying the DESL-0.4% eutectogel can (a) be stretched, (b) lift a weight and (c) show excellent compressive recovery behavior.

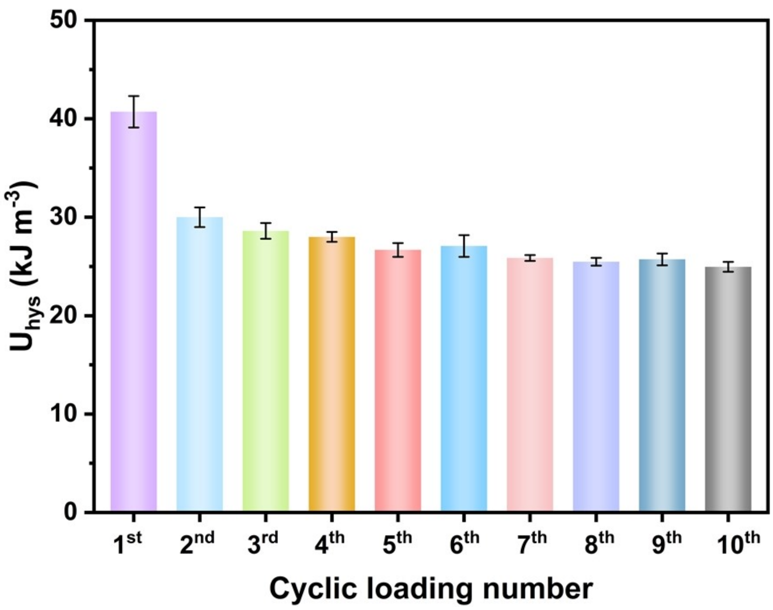

Fig. S4. The dissipated energy (U_{hys}) values of the DESL-0.4% eutectogel during continuous loading-unloading cycles under 100% tensile strain.

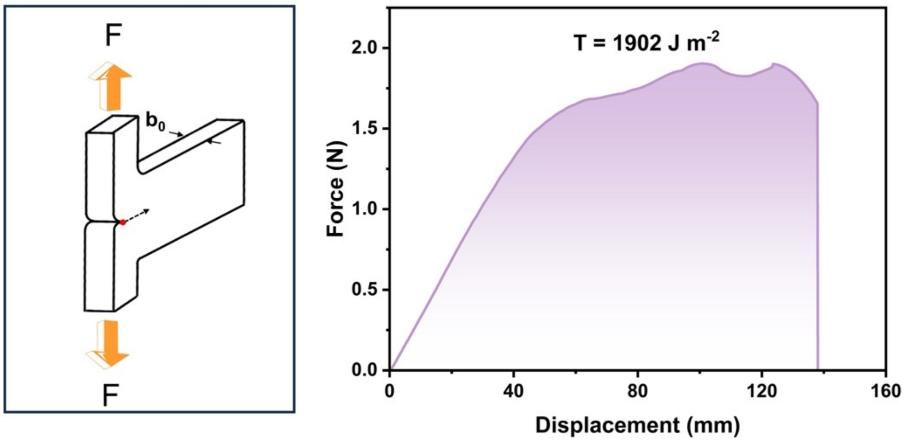

Fig. S5. Trouser tearing test and tearing curves of DESL-0.4% eutectogel.

For the tearing test, the rectangular samples (40 mm × 10 mm × 2 mm) with a 20 mm notch in the length were used, and the tearing energy (T, kJ m^{-2}) was calculated according to the equation:

$$T = \frac{2F}{b_0} \tag{1}$$

where F (N) was the constant strength force and b_0 (m) represents the thickness of the sample.

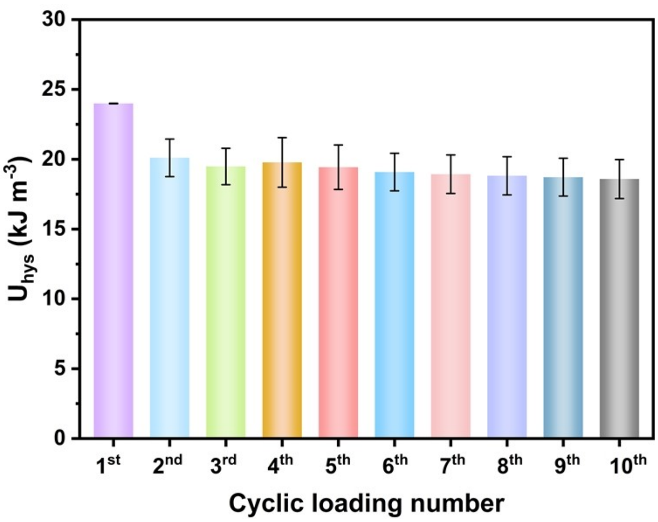

Fig. S6. Dissipated energy (Uhys) after the DESL-0.4% cycle compression.

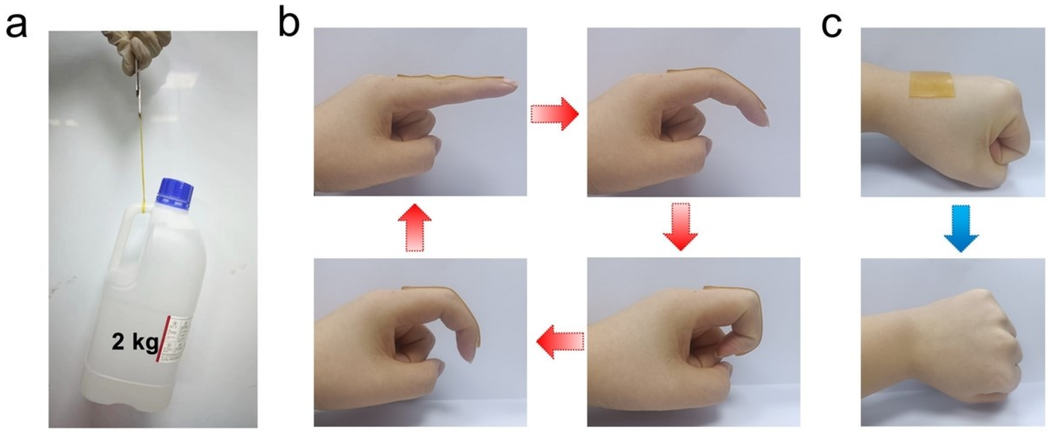

Fig. S7. Adhesion performance demonstration. (a) Photograph displaying that Fe sheets bonded by DESL-0.4% eutectogel could lift a 2 kg weight. (b) DESL-0.4% eutectogel directly adheres to fingers moving with the joints. (c) Diagram of DESL-0.4% eutectogel adhering to the skin surface and the skin surface after peeling off the eutectogel.

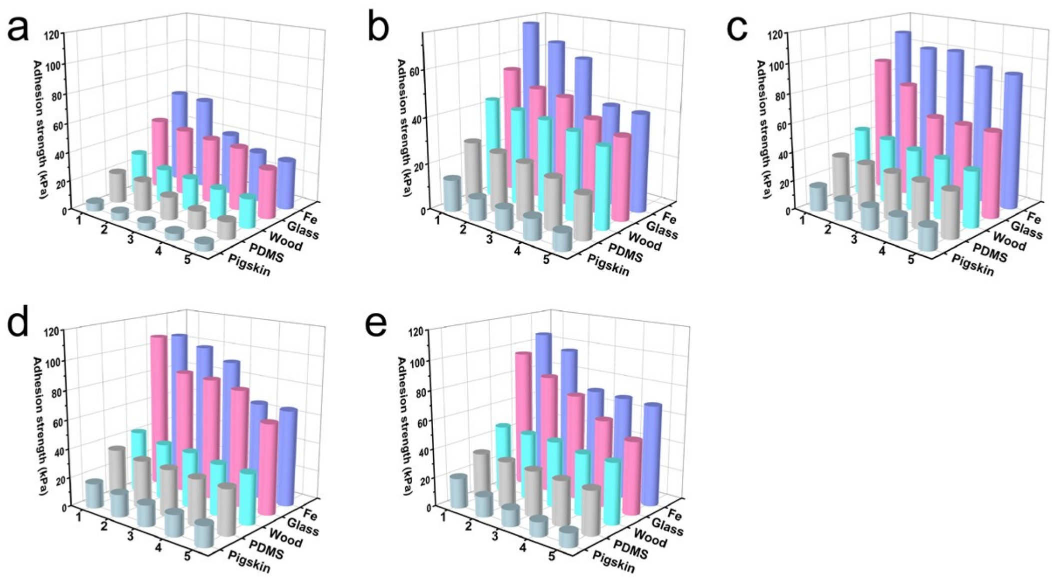

Fig. S8. Repeated adhesion strength of the a) DESL-0.0%, b) DESL-0.2%, c) DESL-0.6%, d) DESL-0.8%, and e) DESL-1.0%, respectively.

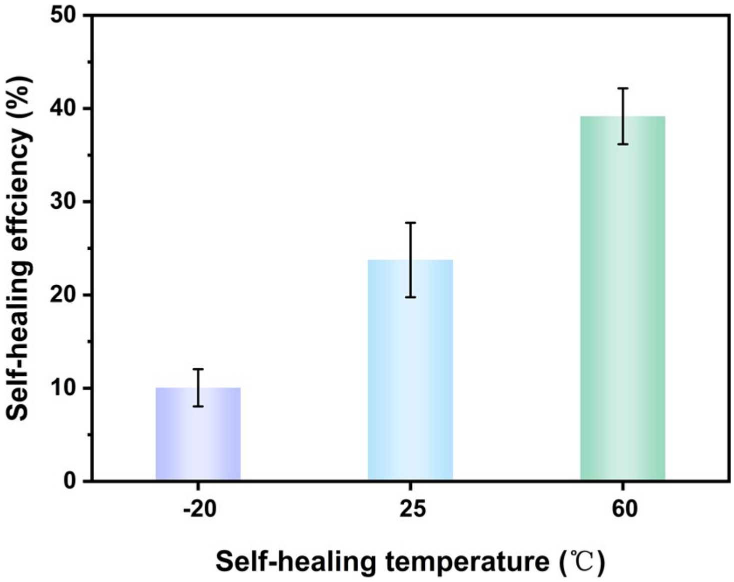

Fig. S9. Self-healing efficiency of DESL-0.4% eutectogel samples under different temperatures for 24 h.

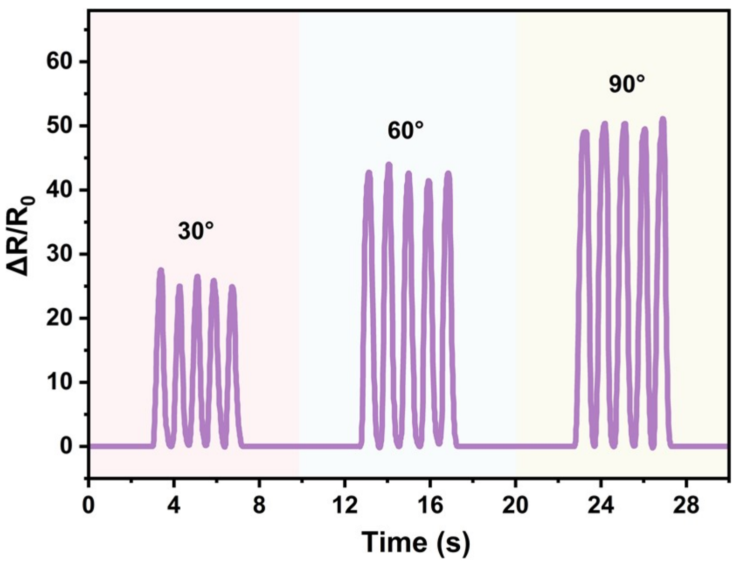

Fig. S10. Finger bending movement monitored by the self-healed DESL-0.4% strain sensor.

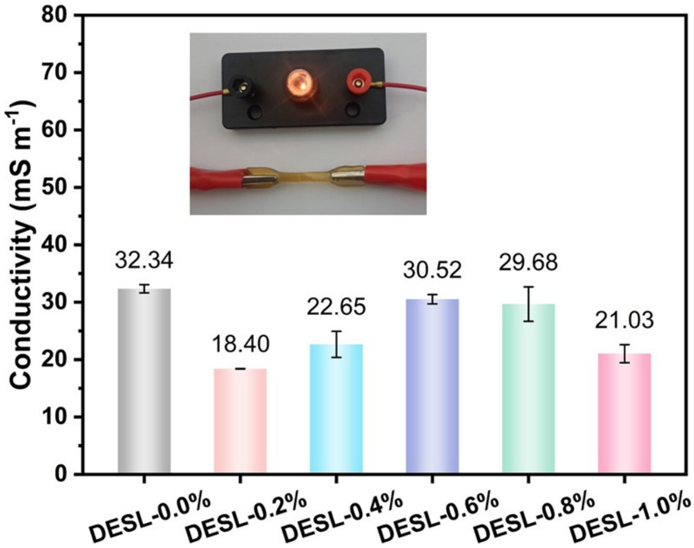

Fig. S11. Conductivity of the DESL eutectogels. (Inset: demonstration of the conductivity of the DESL-0.4% eutectogel by lighting a bulb)

Conductivity (σ, mS m^{-1}) of DESL-0.4% eutectogel was obtained by the equation: $\sigma = L/(R\times A)$, where R was the resistance value, and L and A represented the length and cross-sectional area of the samples, respectively.

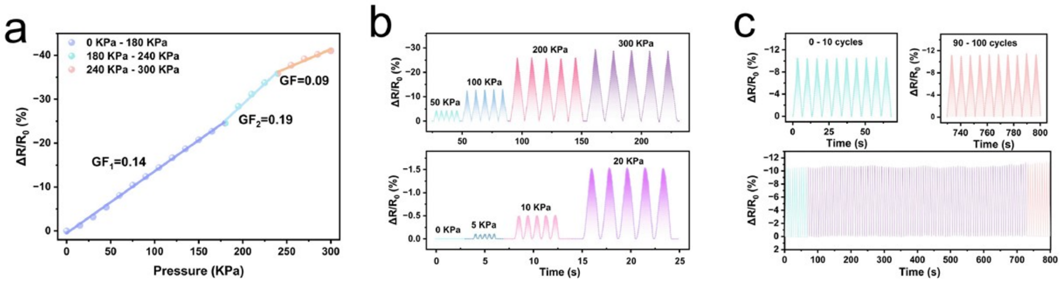

Fig. S12. Sensing performance of DESL-0.4% pressure sensor. a) Resistance response of the DESL-0.4% pressure sensor versus pressure (0 – 300 kPa). b) Relative resistance changes under different pressures for five cycles. c) Relative resistance variation of the DESL-0.4% pressure sensor upon 100 kPa pressure for 100 cycles.

The excellent compression elasticity of the DESL-0.4% eutectogel makes it ideal for a pressure sensor to detect compression stimuli. In contrast to the strain sensing behavior, decreased resistance could be observed with consecutive increases in the compression pressure, due to the shortening of the ionic transport pathway. The GF of the DESL-0.4% pressure sensor for the compression showed three distinct stages of response in the compression range of 0 – 300 kPa, which were 0.14 kPa^{-1}, 0.19 kPa^{-1}, and 0.09 kPa^{-1} in the compression range of 0 – 180 kPa, 180 – 240 kPa, and 240 – 300 kPa, respectively. The detection sensitivity in a wide strain range makes it suitable for general sensing application scenarios. In addition, the sensor can accurately and repeatedly identify pressure from 5 to 300 kPa. The stability of the DESL-0.4% pressure sensor under cyclic compression loading-unloading testing up to 100 kPa pressure showed that the pressure sensing property is stable for over 100 cycles with almost no decay in the resistance change. Moreover, negligible electrical hysteresis could be observed from the 100 cycles, indicating outstanding stability and cyclicity.