

## SUPPLEMENTARY INFORMATION

The mechanical properties of NIPA hydrogel under monotonic load at the loading strain rate of 0.01mm/min is shown as following:

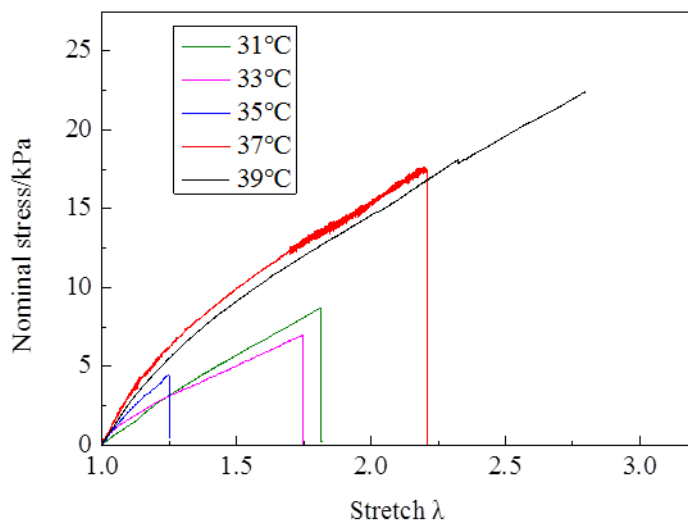


Figure. S1 Stress-stretch curves vary with temperatures

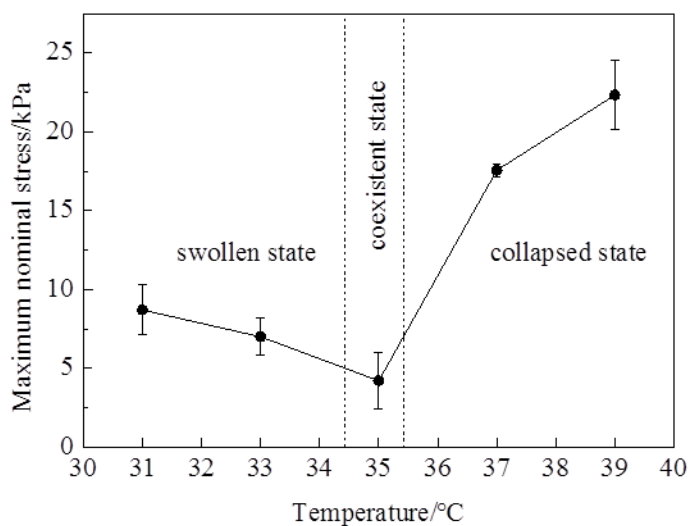
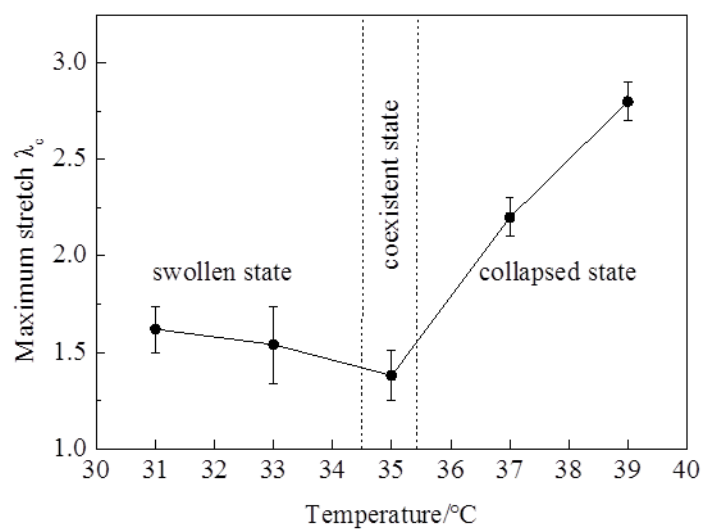
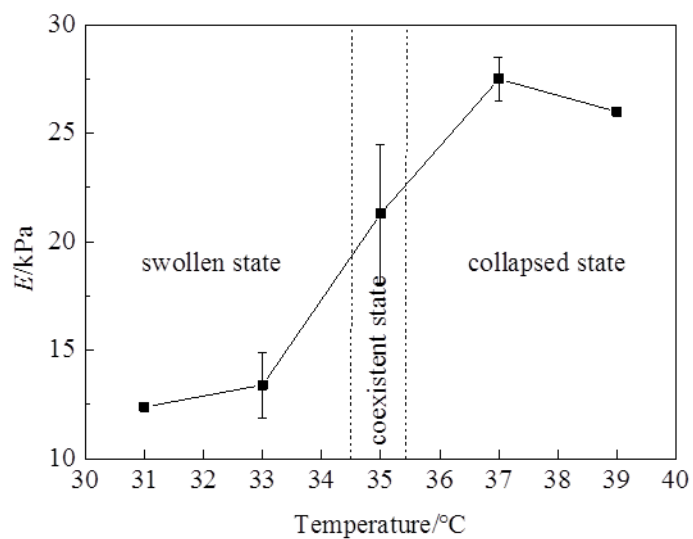


Figure.S2 Maximum nominal stress varies with temperatures

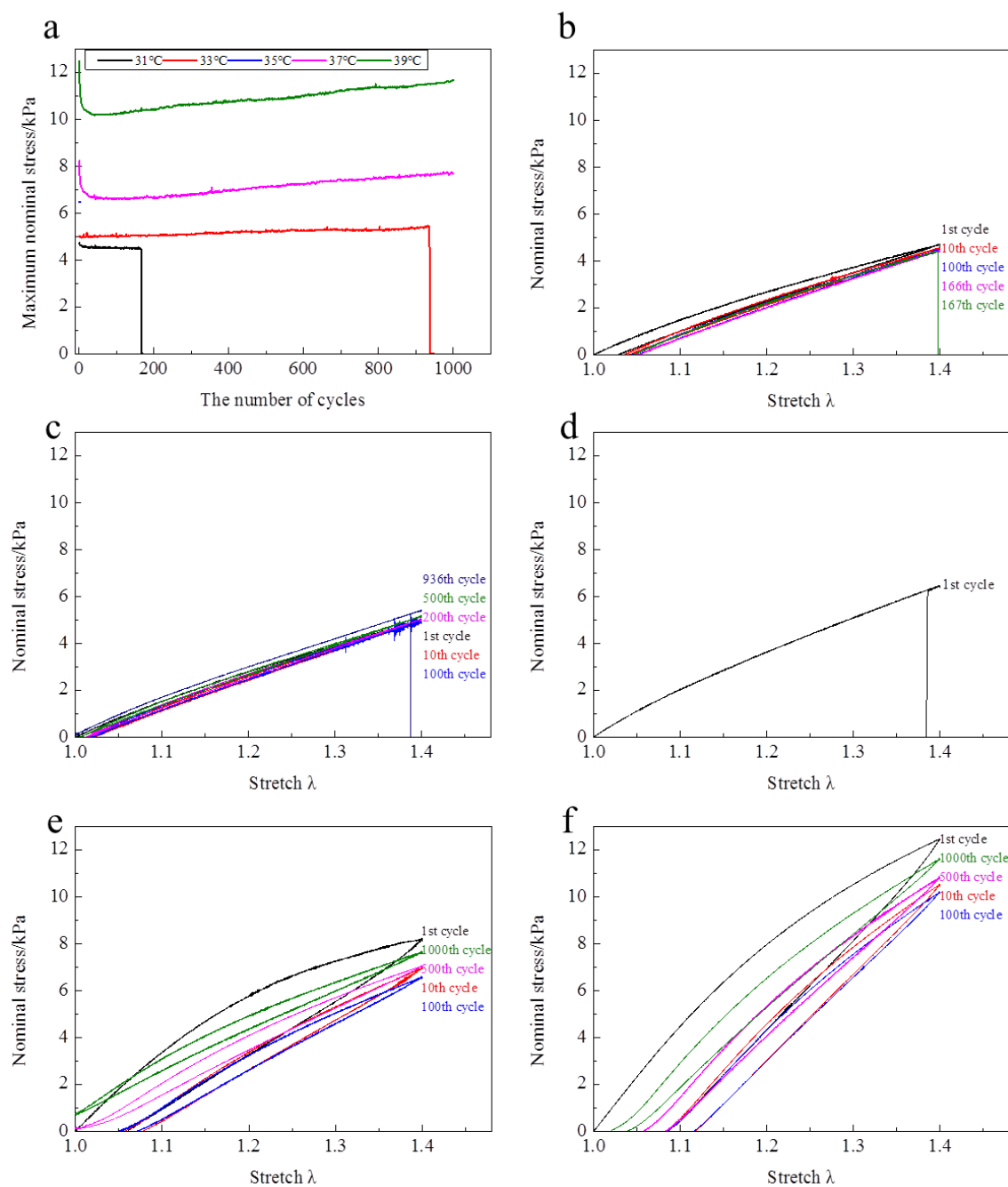


**Figure.S3** Maximum stretch varies with temperatures

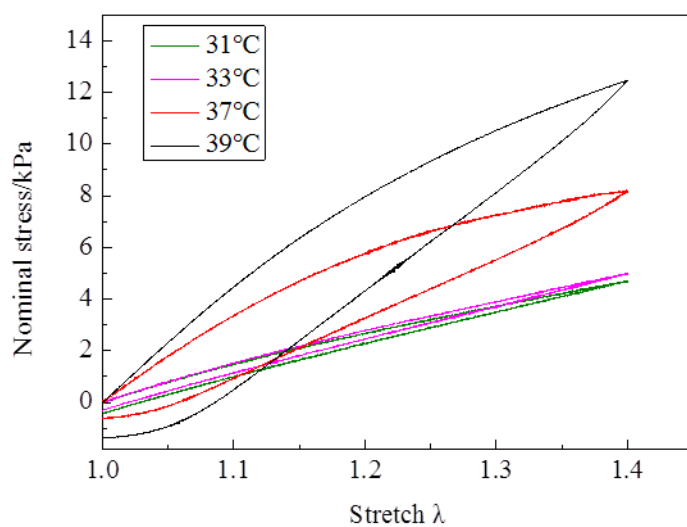


**Figure.S4** The Young's modulus  $E$  varies with temperatures

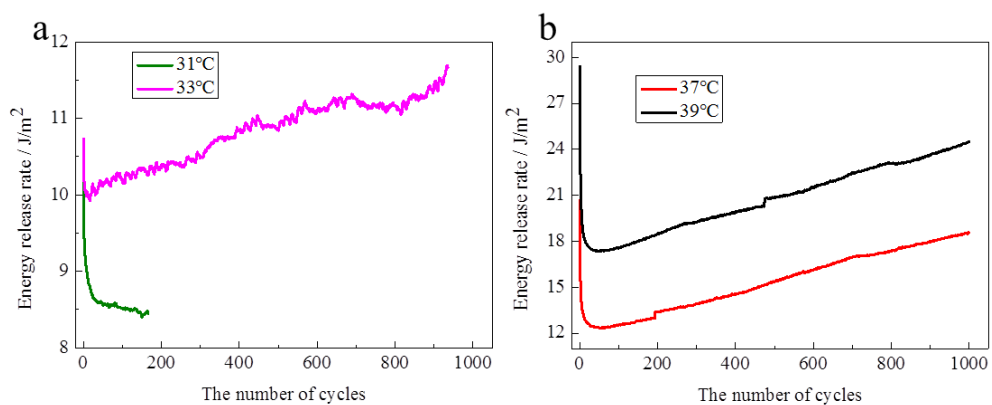
The mechanical properties of NIPA hydrogel under cyclic load at  $\lambda_{\max} = 1.4$  is shown as following:



**Figure.S5** Evolutions of stress - stretch curves over cycles at  $\lambda_{\max} = 1.4$  (a, evolutions of maximum stress in each cycle over cycles; evolutions of stress - stretch curves over cycles at 31°C (b), 33°C (c), 35°C (d), 37°C (e), and 39°C (f))



**Figure.S6** The load - unload stress stretch curves of the 1st cycle vary with temperatures



**Figure.S7** Evolution of energy release rate over cycles (a, below the LCST; b, above the LCST)