

## Supplementary Information

**Table S1.** Compressive properties of the first and second network hydrogels.

	Max stress (kPa)	Max strain	Elastic modulus (kPa)	Toughness (kJ/m <sup>3</sup> )
D0L0	160 ± 12	0.53 ± 0.012	65 ± 8.7	14 ± 0.36
D0L2	160 ± 18	0.54 ± 0.014	74 ± 9.1	15 ± 2.5
D10L0	160 ± 25	0.55 ± 0.011	72 ± 8.8	15 ± 2.1
D5L2	160 ± 13	0.56 ± 0.012	120 ± 11 <sup>a</sup>	18 ± 1.3 <sup>a</sup>
D10L2	180 ± 3.9 <sup>a</sup>	0.62 ± 0.15 <sup>a</sup>	110 ± 8.0 <sup>a</sup>	18 ± 2.0 <sup>a</sup>
D10L4	210 ± 3.1 <sup>a,b</sup>	0.63 ± 0.022 <sup>a</sup>	160 ± 30 <sup>a,b</sup>	20 ± 0.82 <sup>a,b</sup>
PAAm	1200 ± 290 <sup>c</sup>	0.78 ± 0.050 <sup>c</sup>	2.8 ± 0.21 <sup>c</sup>	50 ± 4.5 <sup>c</sup>

<sup>a</sup>  $p < 0.05$  when compared to D0L0, D0L2, and D10L0.

<sup>b</sup>  $p < 0.05$  when compared to D5L2 and D10L2.

<sup>c</sup>  $p < 0.05$  when compared to the first network hydrogels.

**Table S2.** Maximum stress normalized by the second network content in DN ( $\sigma_{\text{normal}}$ )

Formulation	$r$	$\sigma_{\text{normal}}$ (kPa)	$\sigma_{\text{normal}}$ normalized by $\sigma_{\text{normal}}$ of D0L0/DN
D0L0/DN	0.068	23000	1.00
D0L2/DN	0.072	23000	1.00
D10L0/DN	0.075	28000	1.22
D5L2/DN	0.070	29000	1.26
D10L2/DN	0.091	31000	1.35
D10L4/DN	0.062	12000	0.52

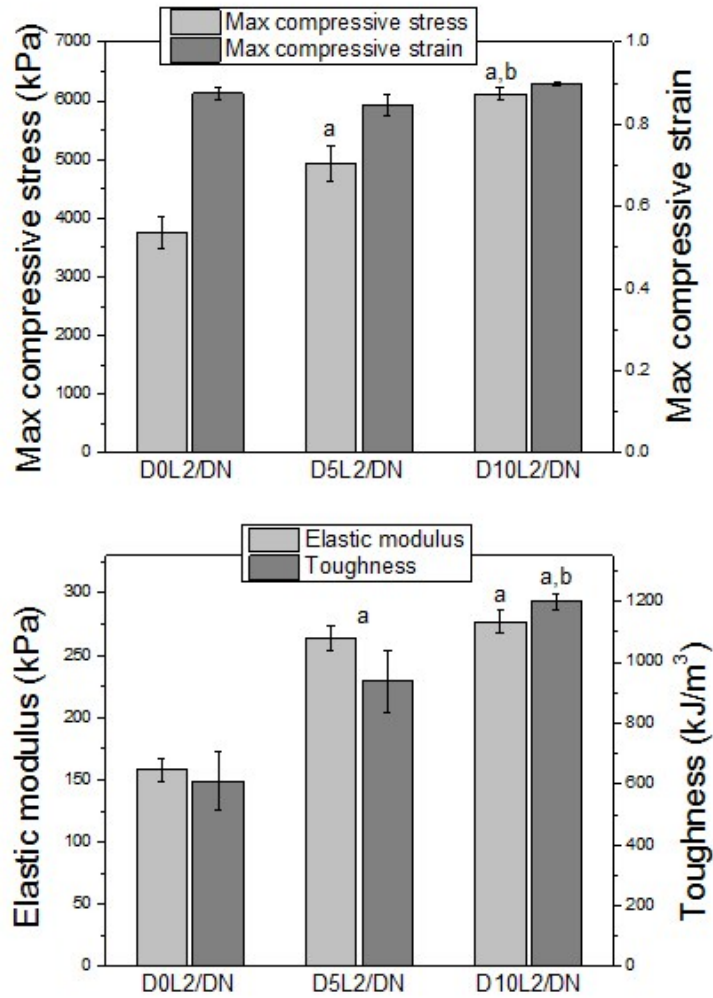
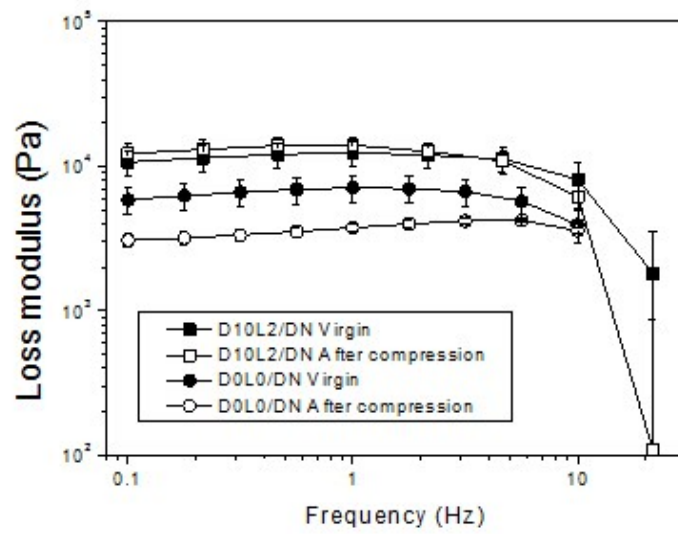


Fig. S1 Measured compressive strength, strain, elastic modulus, and toughness of DN hydrogels. Data is presented as mean  $\pm$  SD (n = 3). <sup>a</sup> p < 0.05 when compared to D0L2/DN, <sup>b</sup> p < 0.05 when compared to D5L2/DN.



**Fig. S2** Loss modulus ( $G''$ ) of D0L0/DN (circles) and D10L2/DN (squares) hydrogels in the virgin state (filled symbols) and after compression to a strain of 0.5 (open symbols). Data were presented as mean  $\pm$  SD ( $n = 3$ ).