

Supplementary information

Viscous solvent embrittles long-chain polymer networks

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Table S1. Viscosity as a function of glycerol concentration φ_g .

φ_g (%)	η (Pa·s)
0	1.00E-03
50	1.45E-02
75	1.31E-01
90	1.31E+00

Table S2. Swelling ratio of fully dried hydrogels over time.

φ_g (%)	Elapsed time (min)	Swelling ratio
0	0	1
0	15	2.31
0	25	3.51
0	40	4.29
0	50	4.75
0	56	5.00
50	0	1.00
50	15	1.32
50	25	1.60
50	40	1.95
50	50	2.26
50	95	3.99
50	125	4.71

50	165	5.06
75	0	1
75	60	1.81
75	180	3.99
75	200	4.59
75	250	4.66
75	300	5.09
90	0	1
90	180	1.40
90	360	2.03
90	480	3.75
90	600	5.06

Table S3. Comparison of modulus values with various values of η and two values of C .

η (Pa·s)	C	Young's modulus (kPa)
1.00E-03	1.00E-03	204.02
1.00E-03	1.00E-03	202.82
1.00E-03	1.00E-03	163.01
1.00E-03	1.00E-03	80.84
1.00E-03	1.00E-03	130.59
1.00E-02	1.00E-03	263.35
1.00E-02	1.00E-03	256.78
1.00E-02	1.00E-03	221.86
1.00E-02	1.00E-03	235.93
1.00E-02	1.00E-03	232.14
1.00E-01	1.00E-03	218.43
1.00E-01	1.00E-03	195.83
1.00E-01	1.00E-03	224.14
1.00E-01	1.00E-03	209.16
1.00E-01	1.00E-03	224.04
1.00E+00	1.00E-03	194.13

1.00E+00	1.00E-03	210.35
1.00E+00	1.00E-03	247.97
1.00E+00	1.00E-03	170.96
1.00E+00	1.00E-03	185.71
1.00E-03	1.00E-05	480.06
1.00E-03	1.00E-05	494.62
1.00E-03	1.00E-05	439.1
1.00E-03	1.00E-05	473.15
1.00E-03	1.00E-05	487.82
1.00E-02	1.00E-05	499.96
1.00E-02	1.00E-05	481.45
1.00E-02	1.00E-05	493.71
1.00E-02	1.00E-05	532.21
1.00E-02	1.00E-05	522.81
1.00E-01	1.00E-05	520.01
1.00E-01	1.00E-05	499.37
1.00E-01	1.00E-05	486.57
1.00E-01	1.00E-05	458.76
1.00E-01	1.00E-05	495.96
1.00E+00	1.00E-05	503.06
1.00E+00	1.00E-05	528.06
1.00E+00	1.00E-05	522.14
1.00E+00	1.00E-05	475.36
1.00E+00	1.00E-05	510.67

Table S4. Comparison of strength values with various values of η and two values of C.

η (Pa·s)	C	Strength (kPa)
1.00E-03	1.00E-03	1052
1.00E-03	1.00E-03	1314
1.00E-03	1.00E-03	1060.8
1.00E-03	1.00E-03	1327.6
1.00E-03	1.00E-03	1033.4

1.00E-02	1.00E-03	1165.8
1.00E-02	1.00E-03	1076.1
1.00E-02	1.00E-03	944.53
1.00E-02	1.00E-03	938.58
1.00E-02	1.00E-03	851.68
1.00E-01	1.00E-03	700.68
1.00E-01	1.00E-03	696.13
1.00E-01	1.00E-03	731.9
1.00E-01	1.00E-03	693.15
1.00E-01	1.00E-03	687.78
1.00E+00	1.00E-03	276.23
1.00E+00	1.00E-03	299.51
1.00E+00	1.00E-03	335.15
1.00E+00	1.00E-03	314.12
1.00E+00	1.00E-03	307.08
1.00E-03	1.00E-05	698.13
1.00E-03	1.00E-05	1090.5
1.00E-03	1.00E-05	977.08
1.00E-03	1.00E-05	928.67
1.00E-03	1.00E-05	708.26
1.00E-02	1.00E-05	561.48
1.00E-02	1.00E-05	516.26
1.00E-02	1.00E-05	568.15
1.00E-02	1.00E-05	683.46
1.00E-02	1.00E-05	957.94
1.00E-01	1.00E-05	834.67
1.00E-01	1.00E-05	648.85
1.00E-01	1.00E-05	746.61
1.00E-01	1.00E-05	570.47
1.00E-01	1.00E-05	878.88
1.00E+00	1.00E-05	904.7
1.00E+00	1.00E-05	652.03

1.00E+00	1.00E-05	703.91
1.00E+00	1.00E-05	688.46
1.00E+00	1.00E-05	821.72

Table S5. Comparison of stretchability values with various values of η and two values of C .

η (Pa·s)	C	Stretchability
1.00E-03	1.00E-03	7.39
1.00E-03	1.00E-03	7.78
1.00E-03	1.00E-03	7.43
1.00E-03	1.00E-03	7.70
1.00E-03	1.00E-03	7.24
1.00E-02	1.00E-03	7.70
1.00E-02	1.00E-03	7.53
1.00E-02	1.00E-03	7.15
1.00E-02	1.00E-03	7.24
1.00E-02	1.00E-03	6.80
1.00E-01	1.00E-03	6.39
1.00E-01	1.00E-03	6.59
1.00E-01	1.00E-03	6.59
1.00E-01	1.00E-03	6.71
1.00E-01	1.00E-03	6.45
1.00E+00	1.00E-03	3.83
1.00E+00	1.00E-03	4.04
1.00E+00	1.00E-03	4.02
1.00E+00	1.00E-03	4.39
1.00E+00	1.00E-03	4.24
1.00E-03	1.00E-05	3.11
1.00E-03	1.00E-05	4.04
1.00E-03	1.00E-05	3.95
1.00E-03	1.00E-05	3.76
1.00E-03	1.00E-05	3.17
1.00E-02	1.00E-05	2.78

1.00E-02	1.00E-05	2.64
1.00E-02	1.00E-05	2.77
1.00E-02	1.00E-05	3.06
1.00E-02	1.00E-05	3.60
1.00E-01	1.00E-05	3.35
1.00E-01	1.00E-05	3.00
1.00E-01	1.00E-05	3.27
1.00E-01	1.00E-05	2.85
1.00E-01	1.00E-05	3.52
1.00E+00	1.00E-05	3.68
1.00E+00	1.00E-05	3.03
1.00E+00	1.00E-05	3.14
1.00E+00	1.00E-05	3.2091
1.00E+00	1.00E-05	3.4292

Table S6. Comparison of toughness values with various values of η and two values of C.

η (Pa·s)	C	Toughness (J/m ²)
1.00E-03	1.00E-03	29.85
1.00E-03	1.00E-03	56.24
1.00E-03	1.00E-03	60.95
1.00E-03	1.00E-03	29.85
1.00E-02	1.00E-03	93.96
1.00E-02	1.00E-03	88.14
1.00E-02	1.00E-03	61.36
1.00E-02	1.00E-03	54.16
1.00E-01	1.00E-03	77.71
1.00E-01	1.00E-03	86.95
1.00E-01	1.00E-03	93.36
1.00E-01	1.00E-03	110.1
1.00E+00	1.00E-03	218.2
1.00E+00	1.00E-03	230.1
1.00E+00	1.00E-03	248.5

1.00E+00	1.00E-03	248.5
1.00E-03	1.00E-05	1388
1.00E-03	1.00E-05	1662
1.00E-03	1.00E-05	1612
1.00E-03	1.00E-05	1411
1.00E-02	1.00E-05	366.4
1.00E-02	1.00E-05	461.3
1.00E-02	1.00E-05	548.3
1.00E-02	1.00E-05	657.6
1.00E-01	1.00E-05	280.2
1.00E-01	1.00E-05	365.9
1.00E-01	1.00E-05	467.4
1.00E-01	1.00E-05	479.2
1.00E+00	1.00E-05	246.6
1.00E+00	1.00E-05	463.2
1.00E+00	1.00E-05	499.3
1.00E+00	1.00E-05	712.7

Table S7. The toughness Γ of the long-chain gels and the short-chain gels as a function of solvent viscosity η .

η (Pa·s)	ν	C	Toughness (J/m ²)
1.00E-03	8	1.00E-05	2180
1.00E-03	8	1.00E-05	1880
1.00E-03	8	1.00E-05	2080
1.00E-03	8	1.00E-05	2140
1.00E-03	8	1.00E-05	1920
1.00E-03	4	1.00E-05	2100
1.00E-03	4	1.00E-05	2360
1.00E-03	4	1.00E-05	2720
1.00E-03	4	1.00E-05	2500
1.00E-03	4	1.00E-05	2880
1.00E-03	1	1.00E-05	4600

1.00E-03	1	1.00E-05	2600
1.00E-03	1	1.00E-05	5360
1.00E-03	1	1.00E-05	5460
1.00E-03	1	1.00E-05	5140
1.00E-03	0.5	1.00E-05	4220
1.00E-03	0.5	1.00E-05	5180
1.00E-03	0.5	1.00E-05	4980
1.00E-03	0.5	1.00E-05	3540
1.00E-03	0.5	1.00E-05	2740
1.00E-03	0.1	1.00E-05	7200
1.00E-03	0.1	1.00E-05	8700
1.00E-03	0.1	1.00E-05	2840
1.00E-03	0.1	1.00E-05	4780
1.00E-03	0.1	1.00E-05	2360
1.00E-02	8	1.00E-05	1040
1.00E-02	8	1.00E-05	920
1.00E-02	8	1.00E-05	900
1.00E-02	8	1.00E-05	820
1.00E-02	8	1.00E-05	840
1.00E-02	4	1.00E-05	1120
1.00E-02	4	1.00E-05	1080
1.00E-02	4	1.00E-05	1040
1.00E-02	4	1.00E-05	1020
1.00E-02	4	1.00E-05	1060
1.00E-02	1	1.00E-05	960
1.00E-02	1	1.00E-05	1000
1.00E-02	1	1.00E-05	1060
1.00E-02	1	1.00E-05	1280
1.00E-02	1	1.00E-05	1100
1.00E-02	0.5	1.00E-05	1220
1.00E-02	0.5	1.00E-05	940
1.00E-02	0.5	1.00E-05	1540

1.00E-02	0.5	1.00E-05	1160
1.00E-02	0.5	1.00E-05	1140
1.00E-02	0.1	1.00E-05	5160
1.00E-02	0.1	1.00E-05	4400
1.00E-02	0.1	1.00E-05	960
1.00E-02	0.1	1.00E-05	860
1.00E-02	0.1	1.00E-05	1400
1.00E-01	8	1.00E-05	220
1.00E-01	8	1.00E-05	220
1.00E-01	8	1.00E-05	260
1.00E-01	8	1.00E-05	240
1.00E-01	8	1.00E-05	200
1.00E-01	4	1.00E-05	460
1.00E-01	4	1.00E-05	440
1.00E-01	4	1.00E-05	540
1.00E-01	4	1.00E-05	460
1.00E-01	4	1.00E-05	380
1.00E-01	1	1.00E-05	840
1.00E-01	1	1.00E-05	940
1.00E-01	1	1.00E-05	780
1.00E-01	1	1.00E-05	1000
1.00E-01	1	1.00E-05	840
1.00E-01	0.5	1.00E-05	1000
1.00E-01	0.5	1.00E-05	1260
1.00E-01	0.5	1.00E-05	1300
1.00E-01	0.5	1.00E-05	1180
1.00E-01	0.5	1.00E-05	1080
1.00E-01	0.1	1.00E-05	1300
1.00E-01	0.1	1.00E-05	1200
1.00E-01	0.1	1.00E-05	1400
1.00E-01	0.1	1.00E-05	1400
1.00E-01	0.1	1.00E-05	1300

1.00E+00	8	1.00E-05	1040
1.00E+00	8	1.00E-05	860
1.00E+00	8	1.00E-05	940
1.00E+00	8	1.00E-05	680
1.00E+00	8	1.00E-05	700
1.00E+00	4	1.00E-05	460
1.00E+00	4	1.00E-05	640
1.00E+00	4	1.00E-05	620
1.00E+00	4	1.00E-05	500
1.00E+00	4	1.00E-05	420
1.00E+00	1	1.00E-05	660
1.00E+00	1	1.00E-05	720
1.00E+00	1	1.00E-05	540
1.00E+00	1	1.00E-05	600
1.00E+00	1	1.00E-05	700
1.00E+00	0.5	1.00E-05	560
1.00E+00	0.5	1.00E-05	700
1.00E+00	0.5	1.00E-05	580
1.00E+00	0.5	1.00E-05	480
1.00E+00	0.5	1.00E-05	520
1.00E+00	0.1	1.00E-05	900
1.00E+00	0.1	1.00E-05	840
1.00E+00	0.1	1.00E-05	700
1.00E+00	0.1	1.00E-05	680
1.00E+00	0.1	1.00E-05	920
1.00E-03	8	1.00E-03	340
1.00E-03	8	1.00E-03	400
1.00E-03	8	1.00E-03	300
1.00E-03	8	1.00E-03	280
1.00E-03	8	1.00E-03	320
1.00E-03	4	1.00E-03	160
1.00E-03	4	1.00E-03	140

1.00E-03	4	1.00E-03	120
1.00E-03	4	1.00E-03	160
1.00E-03	4	1.00E-03	140
1.00E-03	1	1.00E-03	280
1.00E-03	1	1.00E-03	300
1.00E-03	1	1.00E-03	260
1.00E-03	1	1.00E-03	280
1.00E-03	1	1.00E-03	260
1.00E-03	0.5	1.00E-03	260
1.00E-03	0.5	1.00E-03	280
1.00E-03	0.5	1.00E-03	280
1.00E-03	0.5	1.00E-03	280
1.00E-03	0.5	1.00E-03	260
1.00E-03	0.1	1.00E-03	260
1.00E-03	0.1	1.00E-03	260
1.00E-03	0.1	1.00E-03	300
1.00E-03	0.1	1.00E-03	320
1.00E-03	0.1	1.00E-03	200
1.00E-02	8	1.00E-03	160
1.00E-02	8	1.00E-03	140
1.00E-02	8	1.00E-03	140
1.00E-02	8	1.00E-03	140
1.00E-02	8	1.00E-03	140
1.00E-02	4	1.00E-03	40
1.00E-02	4	1.00E-03	40
1.00E-02	4	1.00E-03	20
1.00E-02	4	1.00E-03	20
1.00E-02	4	1.00E-03	20
1.00E-02	1	1.00E-03	180
1.00E-02	1	1.00E-03	200
1.00E-02	1	1.00E-03	180
1.00E-02	1	1.00E-03	180

1.00E-02	1	1.00E-03	200
1.00E-02	0.5	1.00E-03	180
1.00E-02	0.5	1.00E-03	140
1.00E-02	0.5	1.00E-03	100
1.00E-02	0.5	1.00E-03	100
1.00E-02	0.5	1.00E-03	60
1.00E-02	0.1	1.00E-03	380
1.00E-02	0.1	1.00E-03	360
1.00E-02	0.1	1.00E-03	380
1.00E-02	0.1	1.00E-03	340
1.00E-02	0.1	1.00E-03	420
1.00E-01	8	1.00E-03	260
1.00E-01	8	1.00E-03	220
1.00E-01	8	1.00E-03	200
1.00E-01	8	1.00E-03	180
1.00E-01	8	1.00E-03	180
1.00E-01	4	1.00E-03	160
1.00E-01	4	1.00E-03	160
1.00E-01	4	1.00E-03	140
1.00E-01	4	1.00E-03	180
1.00E-01	4	1.00E-03	160
1.00E-01	1	1.00E-03	220
1.00E-01	1	1.00E-03	220
1.00E-01	1	1.00E-03	240
1.00E-01	1	1.00E-03	200
1.00E-01	1	1.00E-03	200
1.00E-01	0.5	1.00E-03	160
1.00E-01	0.5	1.00E-03	160
1.00E-01	0.5	1.00E-03	160
1.00E-01	0.5	1.00E-03	160
1.00E-01	0.5	1.00E-03	140
1.00E-01	0.1	1.00E-03	300

1.00E-01	0.1	1.00E-03	300
1.00E-01	0.1	1.00E-03	300
1.00E-01	0.1	1.00E-03	320
1.00E-01	0.1	1.00E-03	320
1.00E+00	8	1.00E-03	640
1.00E+00	8	1.00E-03	560
1.00E+00	8	1.00E-03	620
1.00E+00	8	1.00E-03	600
1.00E+00	8	1.00E-03	640
1.00E+00	4	1.00E-03	1580
1.00E+00	4	1.00E-03	1880
1.00E+00	4	1.00E-03	1900
1.00E+00	4	1.00E-03	1920
1.00E+00	4	1.00E-03	1920
1.00E+00	1	1.00E-03	300
1.00E+00	1	1.00E-03	260
1.00E+00	1	1.00E-03	240
1.00E+00	1	1.00E-03	280
1.00E+00	1	1.00E-03	300
1.00E+00	0.5	1.00E-03	320
1.00E+00	0.5	1.00E-03	320
1.00E+00	0.5	1.00E-03	340
1.00E+00	0.5	1.00E-03	360
1.00E+00	0.5	1.00E-03	380
1.00E+00	0.1	1.00E-03	280
1.00E+00	0.1	1.00E-03	280
1.00E+00	0.1	1.00E-03	280
1.00E+00	0.1	1.00E-03	340
1.00E+00	0.1	1.00E-03	300