

## Supporting Information

### A New soft dielectric silicone elastomer matrix with high mechanical integrity and low losses

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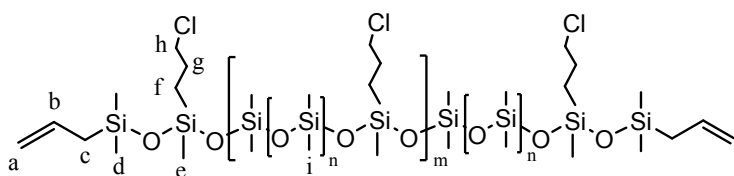
#### Materials:

Hydride-terminated PDMS, DMS-H11 ( $\bar{M}_w \approx 1200 \text{ g mol}^{-1}$  as determined by  $^1\text{H-NMR}$ ), 3-(chloropropyl)methyldimethoxysilane and allyldimethylsilane were acquired from Gelest Inc. Hydride-terminated PDMS ( $\bar{M}_w \approx 580 \text{ g mol}^{-1}$  as stated by supplier) was purchased from Sigma-Aldrich. All other chemicals were acquired from Sigma-Aldrich and used as received, unless otherwise stated.

#### Syntheses:

All reactions were carried out in a nitrogen atmosphere.

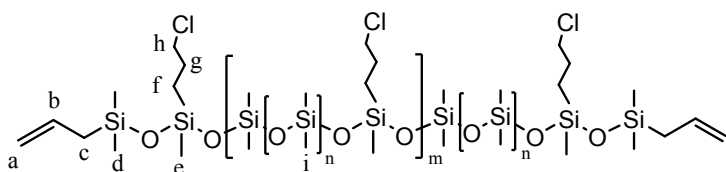
#### $\alpha,\omega$ -Allyl-poly((chloropropyl)methylsiloxane-co-dimethylsiloxane) with a $1200 \text{ g mol}^{-1}$ pre-polymer Co-1:



**Co-1** was synthesised according to a recently published procedure[23] using 3-chloropropylmethyldimethoxysilane (7.23 g, 39.6 mmol), hydride-terminated dimethylsiloxane ( $1200 \text{ g mol}^{-1}$ ) (50 g, 41.7 mmol), tris(pentafluorophenyl)borane (2 mL, 0.04 M, 0.2 mol%), dimethoxydimethylsilane (19.4 g, 163 mmol) and allyldimethylsilane (9.76 g, 97.4 mmol) to produce a slightly yellowish oil (50.0 g, 96.6 %). IR ( $\text{cm}^{-1}$ ): 2960 (C-

H stretch); 2095 ( $\text{-N}_3$  stretch); 1630 ( $\text{C}=\text{C}$  stretch); 1410 ( $\text{Si-CH}_2$  stretch); 1260 ( $\text{Si-CH}_3$  stretch); 1010 ( $\text{Si-O}$  stretch).  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ,  $\delta_{\text{H}}$ , ppm): -0.05-0.09 (m,  $\text{CH}_3\text{-Si}$ ), 0.58 (m,  $\text{-Si-CH}_2\text{-CH}_2\text{-}$ ), 1.50 (d, 4H,  $^3J=8.1$  Hz,  $\text{CH}_2\text{-CH=CH}_2$ ), 1.65 (m,  $\text{-CH}_2\text{-CH}_2\text{-CH}_2\text{-}$ ), 3.23 (t,  $^3J=7.1$  Hz,  $\text{N}_3\text{-CH}_2\text{-CH}_2\text{-}$ ), 4.83 (m, 4H,  $\text{CH=CH}_2$ ), 5.77 (m, 2H,  $\text{CH=CH}_2$ ).  $^{13}\text{C}$ -NMR ( $\text{CDCl}_3$ ,  $\delta_{\text{C}}$ , ppm): -0.55-1.03 (d+e+i), 14.50 (f), 22.77 (g), 23.40 (c), 54.14 (h), 112.51 (a), 135.32 (b). SEC (toluene):  $\bar{M}_w = 29,000$  g mol $^{-1}$ .

**$\alpha,\omega$ -Allyl-poly((chloropropyl)methylsiloxane-co-dimethylsiloxane) with a 580 g mol $^{-1}$  pre-polymer Co-2:**



**Co-2** was synthesised according to a recently published procedure[23] using 3-chloropropylmethyldimethoxysilane (15 g, 82.1 mmol), hydride-terminated dimethylsiloxane (580 g mol $^{-1}$ ) (47.1 g, 81.3 mmol), tris(pentafluorophenyl)borane (4.2 mL, 0.04 M, 0.2 mol%), dimethoxydimethylsilane (39.6 g, 329.4 mmol), allyldimethylsilane (10.0 g, 100 mmol) and to produce a slightly yellowish oil (55.4 g, 92.8 %). IR ( $\text{cm}^{-1}$ ): 2960 ( $\text{C-H}$  stretch); 2095 ( $\text{-N}_3$  stretch); 1630 ( $\text{C}=\text{C}$  stretch); 1410 ( $\text{Si-CH}_2$  stretch); 1260 ( $\text{Si-CH}_3$  stretch); 1010 ( $\text{Si-O}$  stretch).  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ,  $\delta_{\text{H}}$ , ppm): -0.05-0.09 (m,  $\text{CH}_3\text{-Si}$ ), 0.56 (m,  $\text{-Si-CH}_2\text{-CH}_2\text{-}$ ), 1.50 (d, 4H,  $^3J=8.4$  Hz,  $\text{CH}_2\text{-CH=CH}_2$ ), 1.65 (m,  $\text{-CH}_2\text{-CH}_2\text{-CH}_2\text{-}$ ), 3.23 (t,  $^3J=7.2$  Hz,  $\text{N}_3\text{-CH}_2\text{-CH}_2\text{-}$ ), 4.83 (m, 4H,  $\text{CH=CH}_2$ ), 5.77 (m, 2H,  $\text{CH=CH}_2$ ).  $^{13}\text{C}$ -NMR ( $\text{CDCl}_3$ ,  $\delta_{\text{C}}$ , ppm): -0.55-1.03 (d+e+i), 14.51 (f), 22.79 (g), 23.40 (c), 54.14 (h), 112.56 (a), 135.27 (b). SEC (toluene):  $\bar{M}_w = 29,000$  g mol $^{-1}$ .

## Compositions for elastomer synthesis:

Table S1: Compositions of the prepared samples.

Entry	Composition	Quantities			
		Co-1	Co-2	DMS-V31	Cross-linker
<b>DMS-V31</b>	Reference sample with DMS-V31	-	-	4.00 g/0.014 mmol	0.14g/0.007 mmol
<b>Co-1_50</b>	50 mol% DMS-V31 + 50 mol% <b>Co-1</b>	2.00 g/0.007 mmol	-	1.93 g/0.007 mmol	0.13g/0.007 mmol
<b>Co-1</b>	Pure <b>Co-1</b>	4.00 g/0.014 mmol	-	-	0.13g/0.007 mmol
<b>Co-2_25</b>	75 mol% DMS-V31 + 25 mol% <b>Co-2</b>	-	1.00 g/0.038 mmol	2.90 g/0.010 mmol	0.13g/0.007 mmol
<b>Co-2_50</b>	50 mol% DMS-V31 + 50 mol% <b>Co-2</b>	-	2g/0.007 mmol	1.93 g/0.007 mmol	0.13g/0.007 mmol
<b>Co-2</b>	Pure <b>Co-2</b>	-	4.00 g/0.014 mmol	-	0.13g/0.007 mmol

### Thermal gravimetric analysis (TGA):

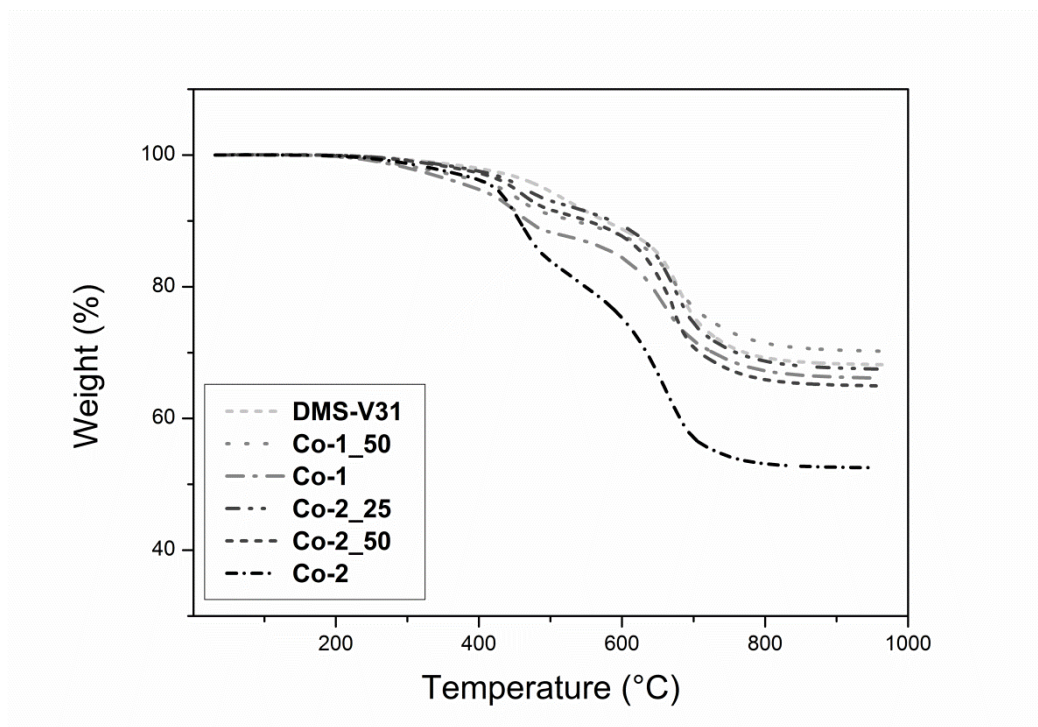


Figure S2: TGA measurements of the prepared elastomer films.