

Supporting Information

Synthesis of solvent-free processable and on-demand cross-linkable dielectric elastomers for actuators

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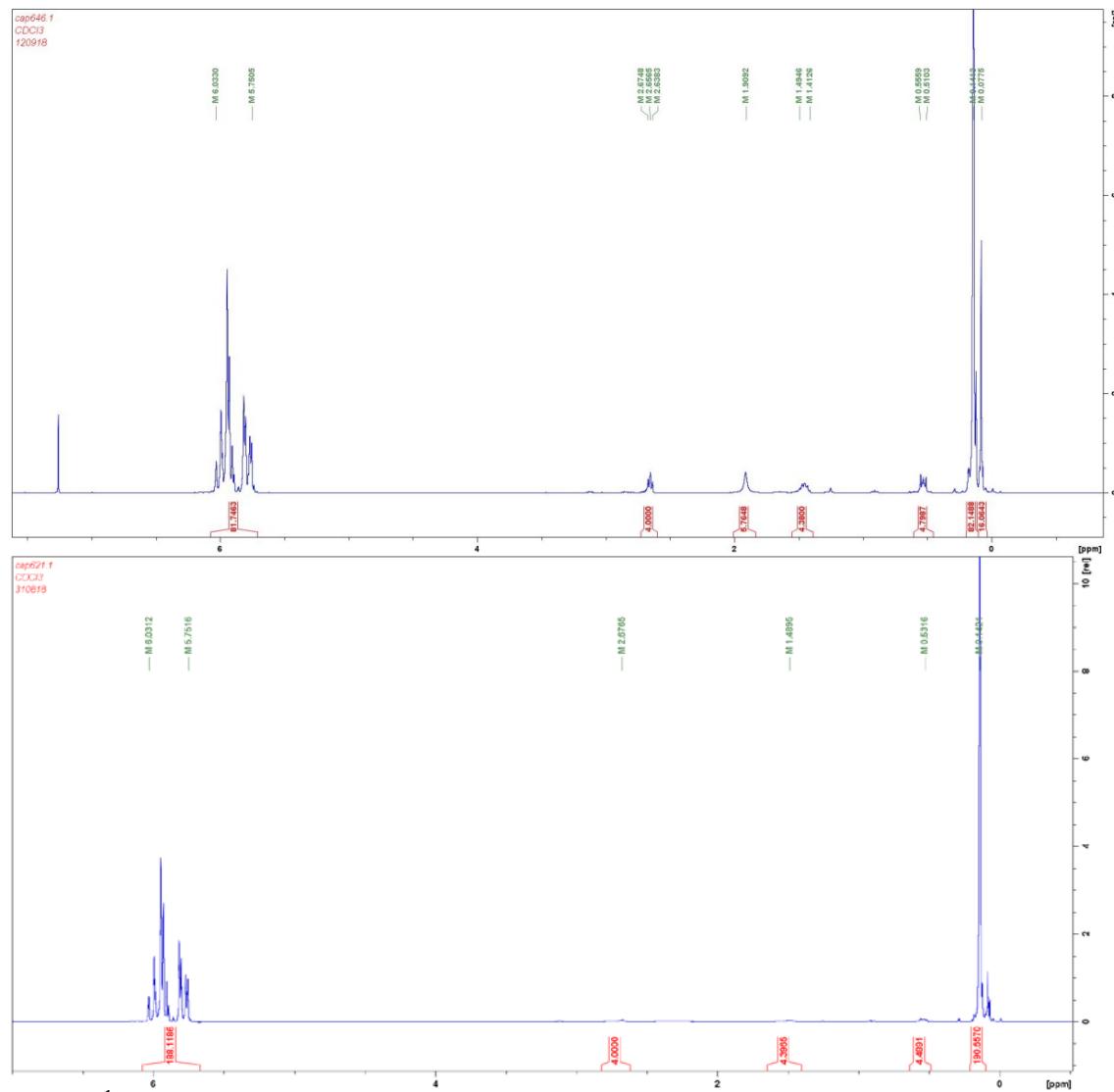


Figure S1 ^1H NMR spectrum of **P1** ($M_n = 2500 \text{ g/mol}$) (top) and ($M_n = 5600 \text{ g/mol}$) bottom in CDCl_3 .

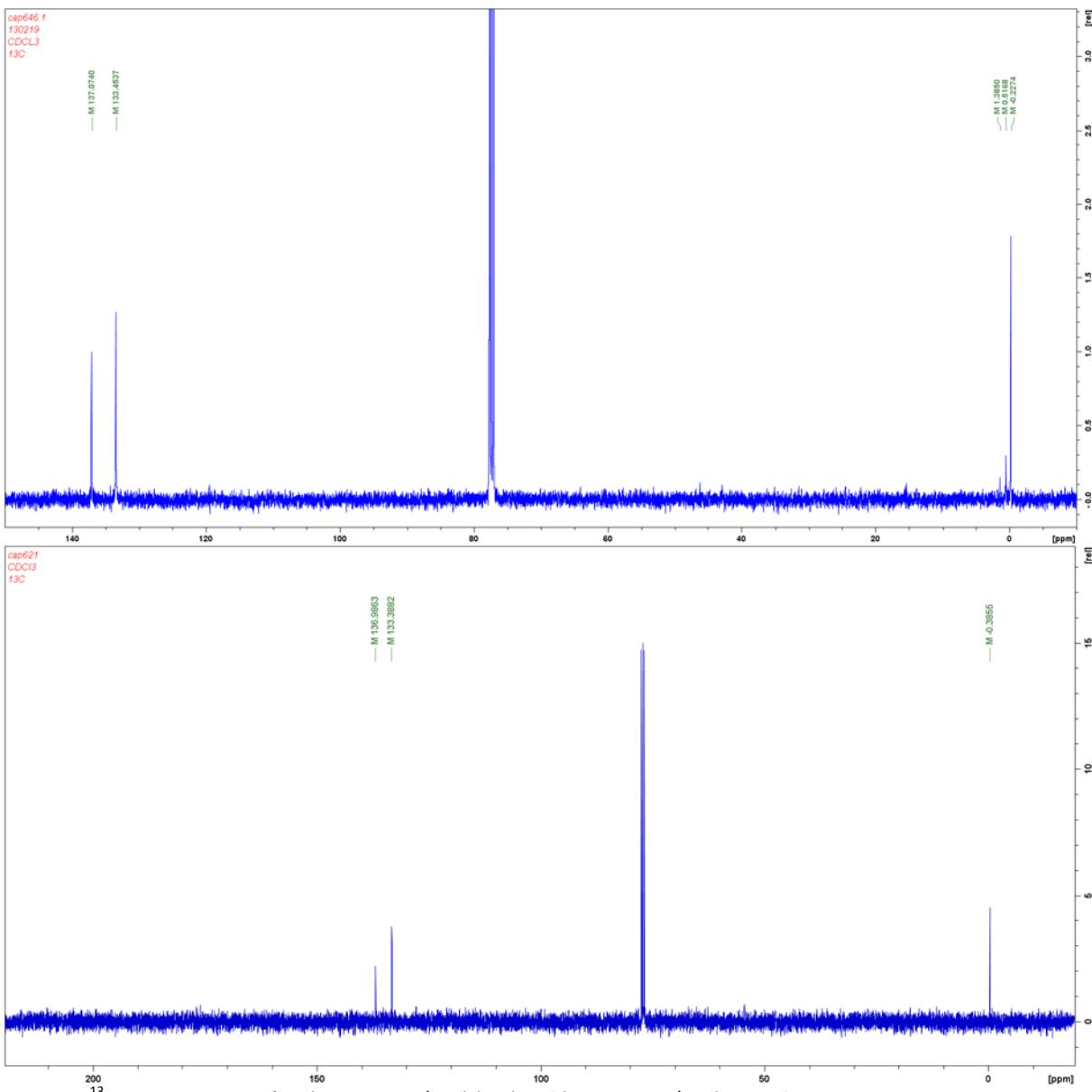


Figure S2 ^{13}C NMR spectrum of **P1** ($M_n = 2500 \text{ g/mol}$) (top) and ($M_n = 5600 \text{ g/mol}$) in CDCl_3 .

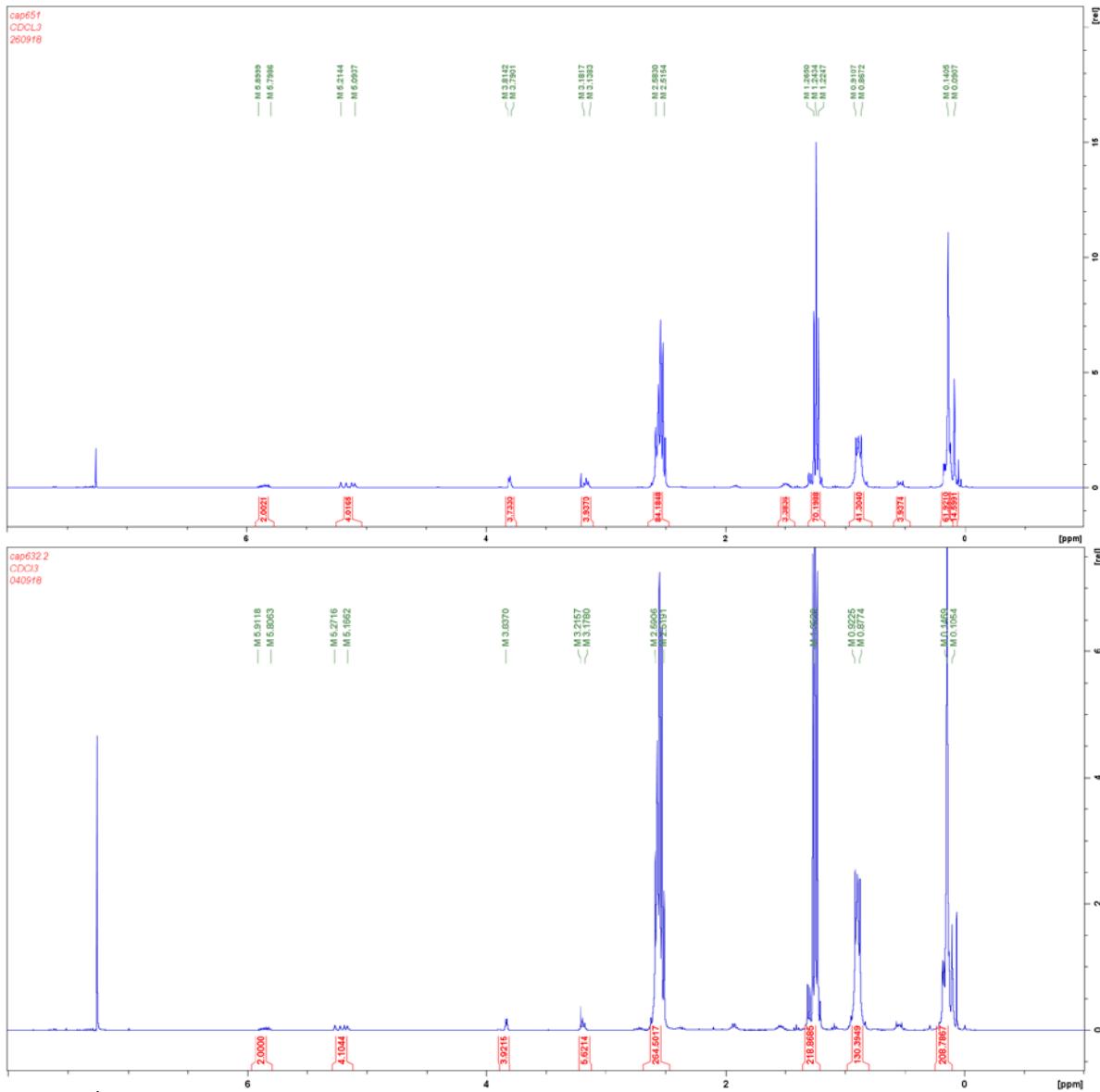


Figure S3 ^1H NMR spectrum of **P3** ($M_n = 3500 \text{ g/mol}$ (top) and $M_n = 10000 \text{ g/mol}$) in CDCl_3 .

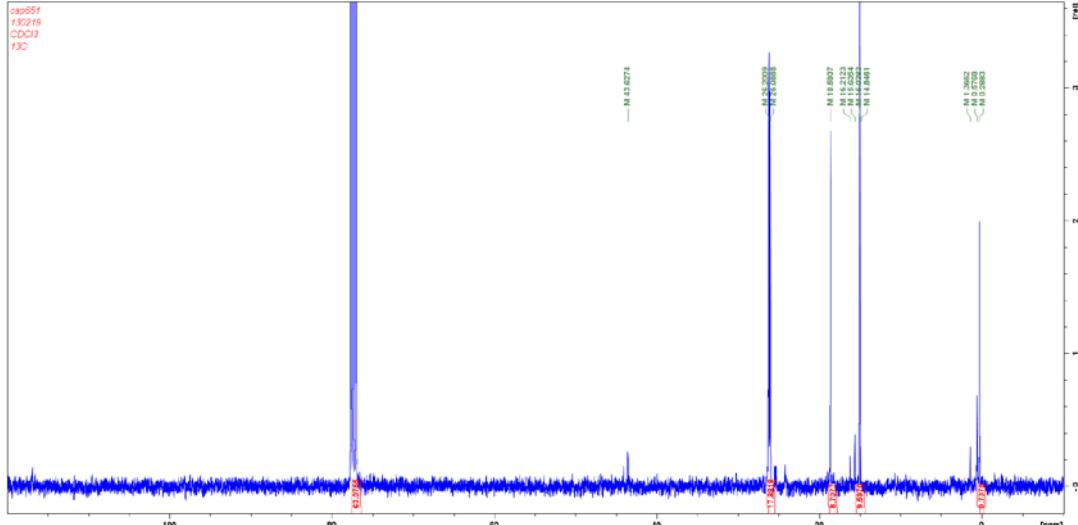


Figure S4 ^{13}C NMR spectrum of **P3** ($M_n = 3500 \text{ g/mol}$) in CDCl_3 .

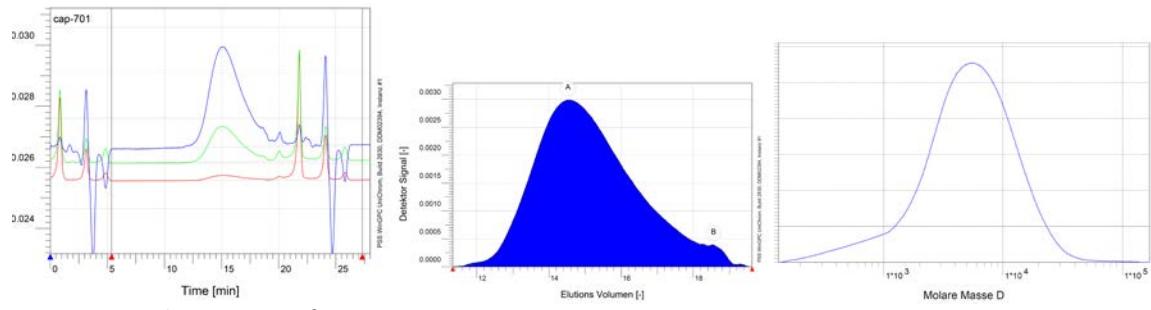


Figure S5 GPC elution curves of **P3**. $M_n = 3000$, $M_w = 7000$, PDI = 2.4.

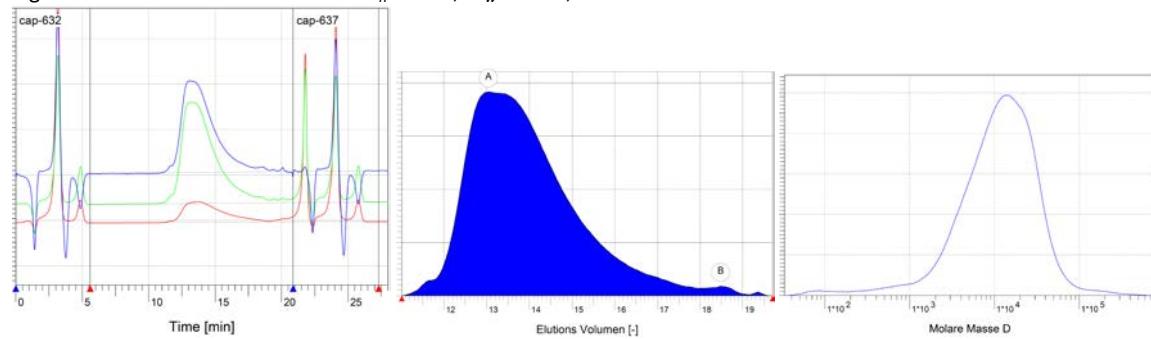


Figure S6 GPC elution curves of **P3.2**. $M_n = 3000$, $M_w = 18000$, PDI = 5.5

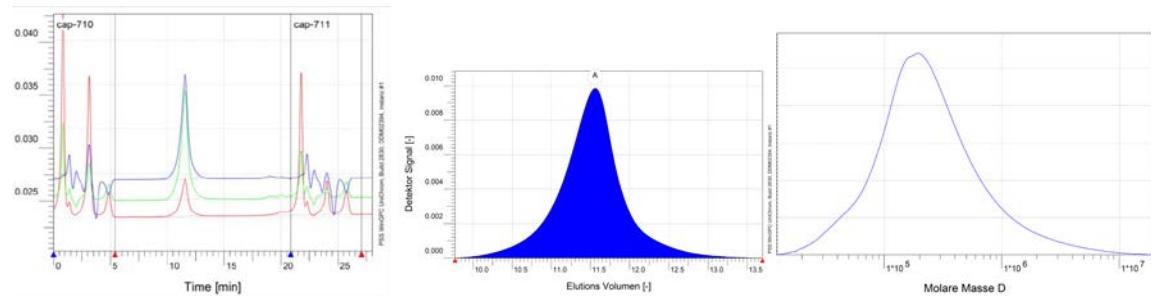


Figure S7 GPC elution curves of **P4**. $M_n = 150.000$, $M_w = 450.000$, PDI = 2.4.

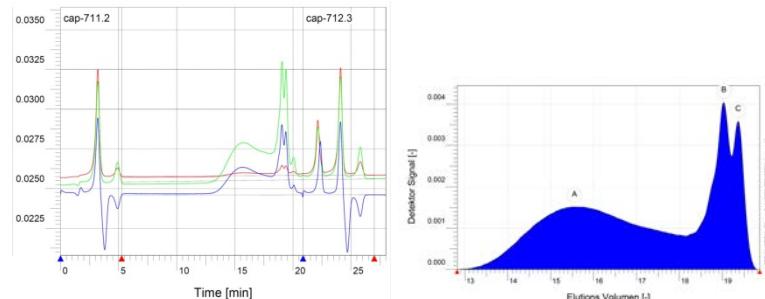


Figure S8 GPC elution curves of the depolymerization of **P4** under basic conditions.

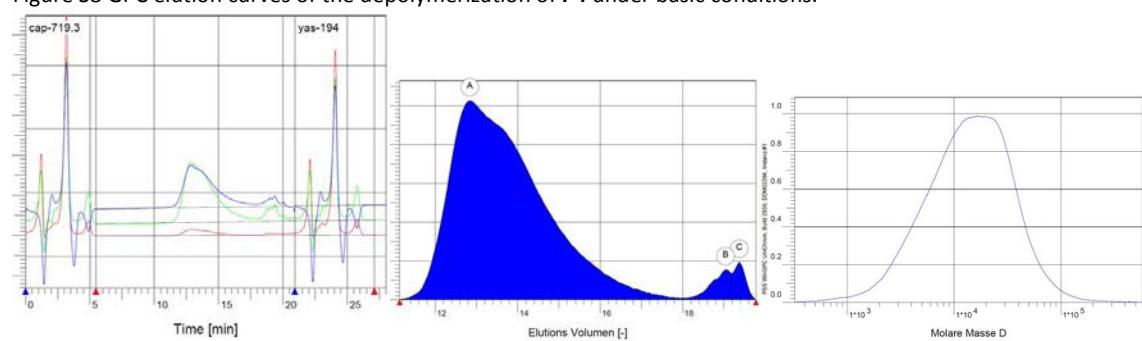


Figure S9 GPC elution curves of **P5**. $M_n = 8500$, $M_w = 20000$, PDI = 2.4.

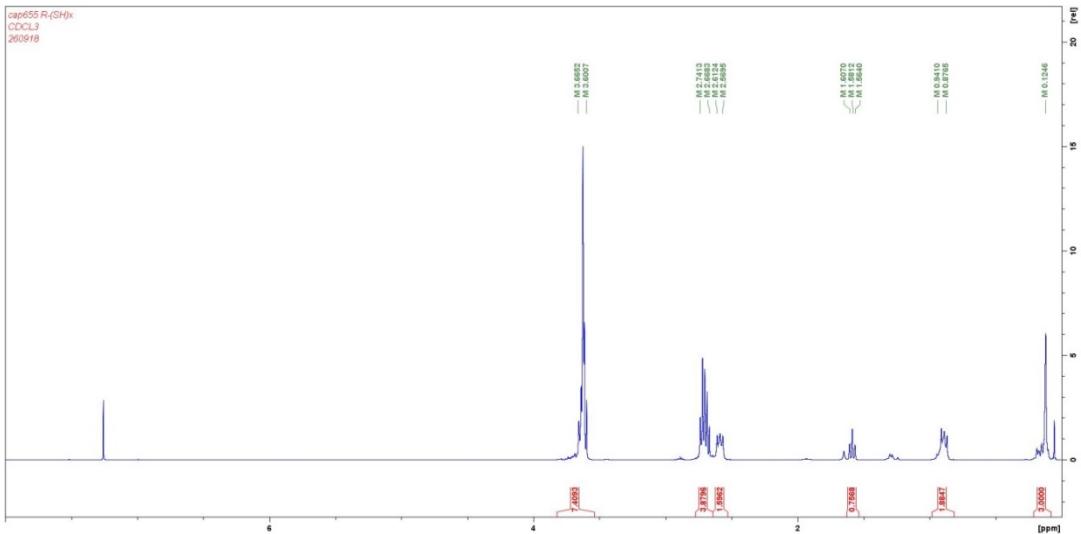


Figure S10 ^1H NMR spectrum of $\text{R}(\text{SH})_3$ in CDCl_3 .

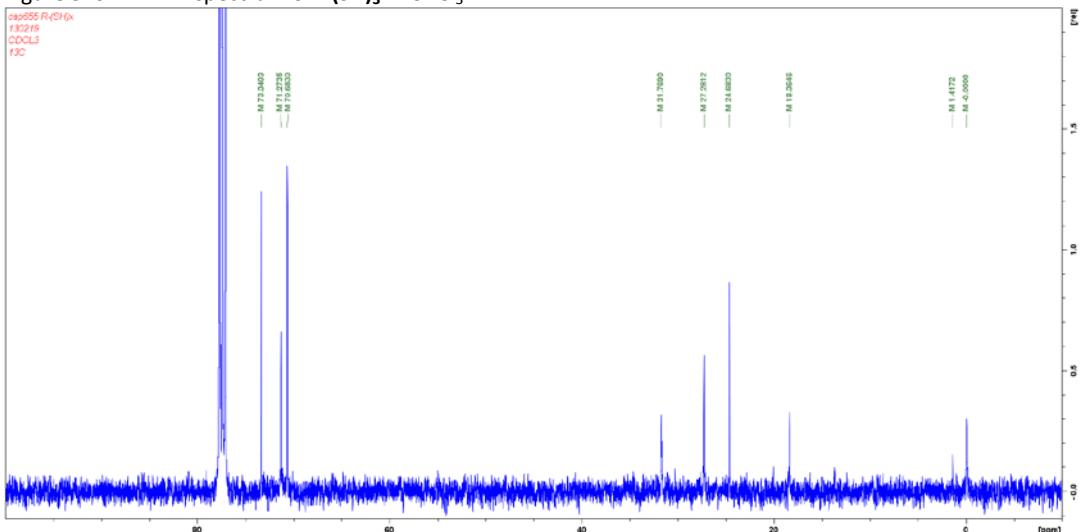


Figure S11 ^{13}C NMR spectrum of $\text{R}(\text{SH})_3$ in CDCl_3 .

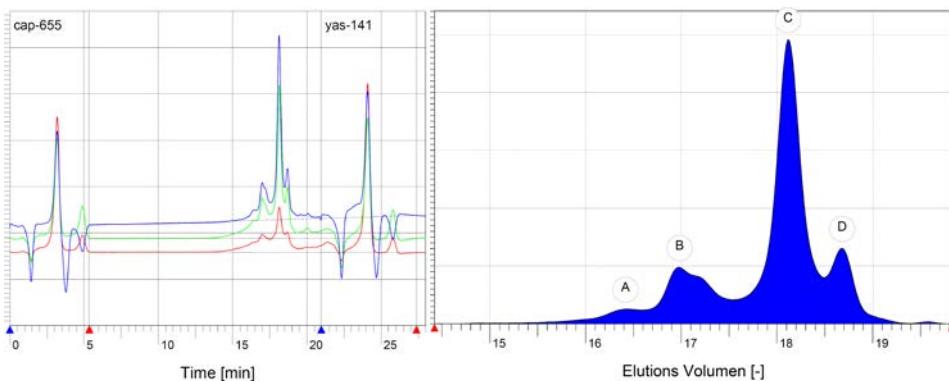


Figure S12 GPC elution curves of $\text{R}(\text{SH})_3$.

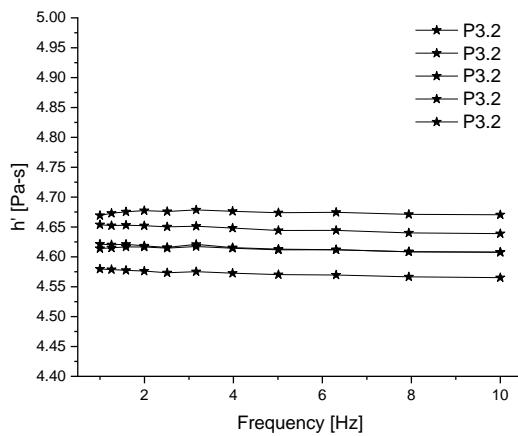


Figure S13 Viscosity of **P3.2** measured in the frequency range of 1-10 Hz. Five measurements were performed.

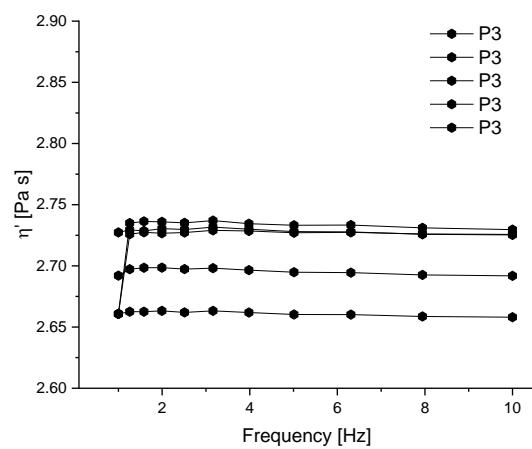


Figure S14 Viscosity of **P3** measured in the frequency range of 1-10 Hz. Five measurements were performed.

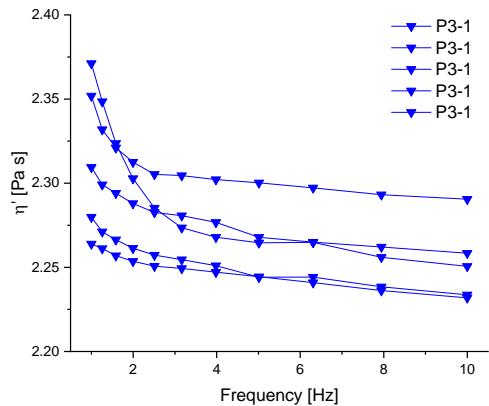


Figure S15 Viscosity of **P3-1** measured in the frequency range of 1-10 Hz. Five measurements were performed.

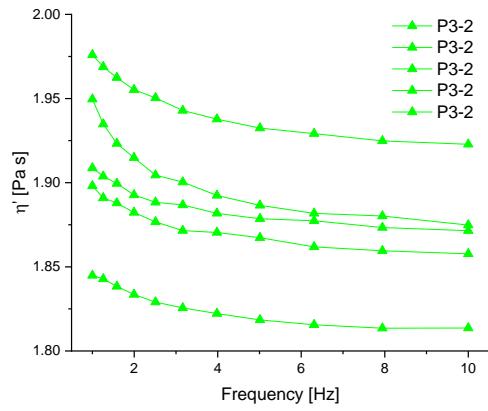


Figure S16 Viscosity of **P3-2** measured in the frequency range of 1-10 Hz. Five measurements were performed.

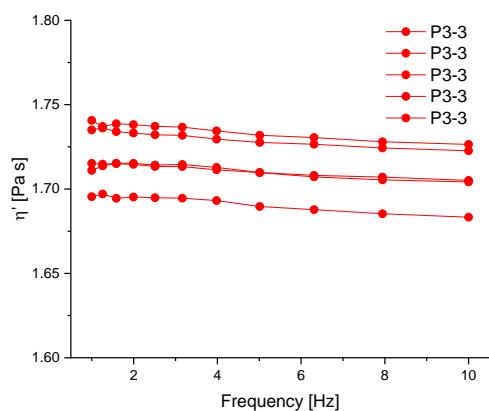


Figure S17 Viscosity of **P3-3** measured in the frequency range of 1-10 Hz. Five measurements were performed.

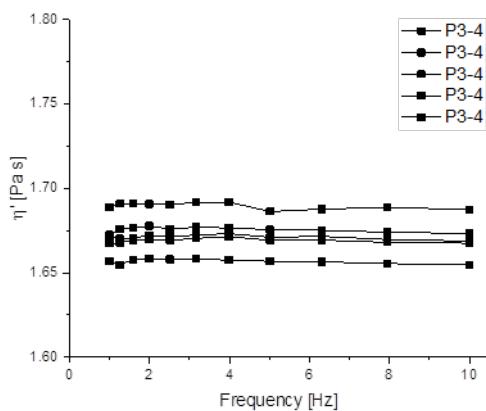


Figure S18 Viscosity of **P3-4** measured in the frequency range of 1-10 Hz. Five measurements were performed.

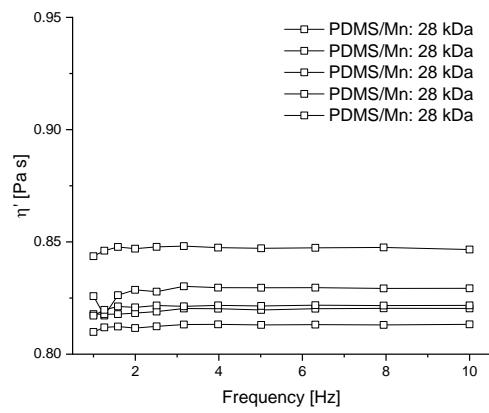


Figure S19 Viscosity of $\alpha'\omega$ -OH-PDMS ($M_n = 28$ kDa) measured in the frequency range of 1-10 Hz. Five measurements were performed.

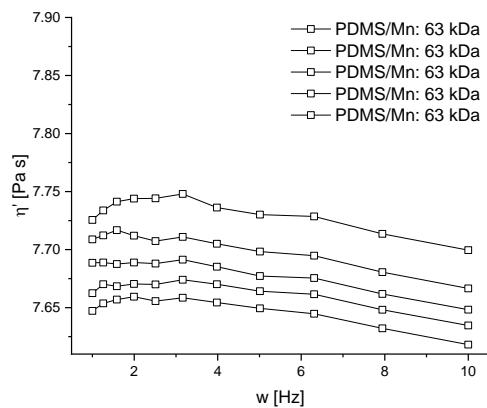


Figure S20 Viscosity of $\alpha'\omega$ -OH-PDMS ($M_n = 63$ kDa) measured in the frequency range of 1-10 Hz. Five measurements were performed.

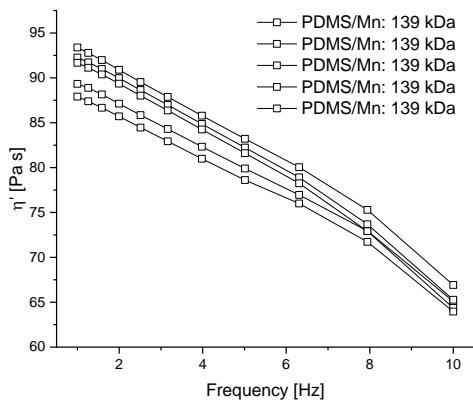


Figure S21 Viscosity of $\alpha'\omega$ -OH-PDMS ($M_n = 139$ kDa) measured in the frequency range of 1-10 Hz. Five measurements were performed.

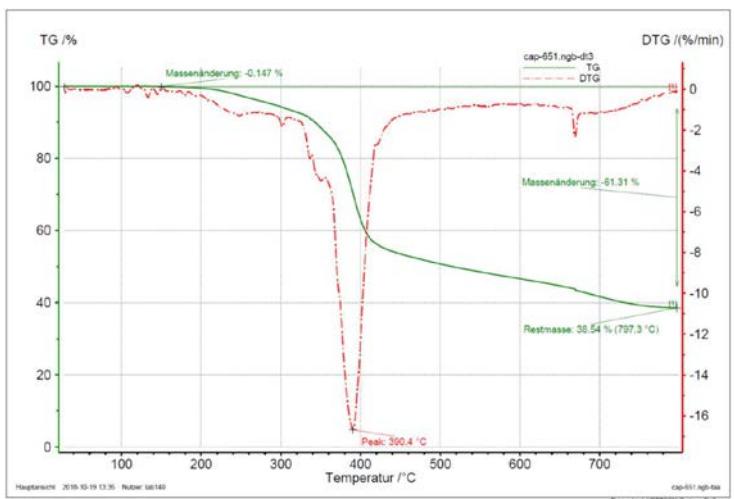


Figure S22 TGA curve of **P3** in air.

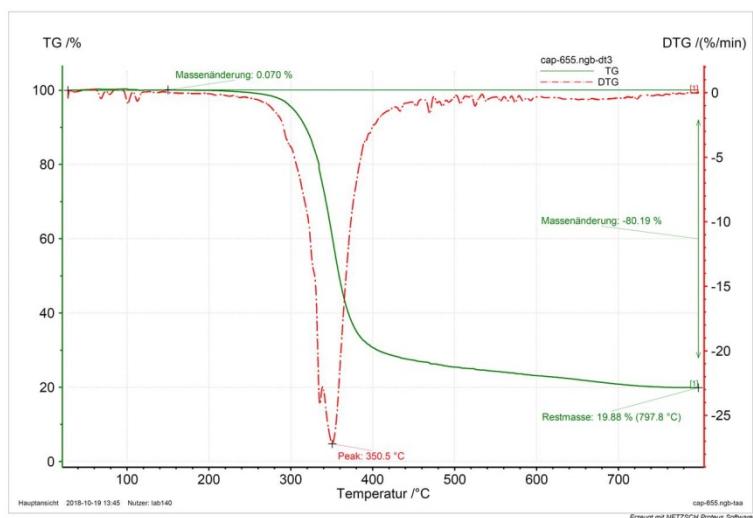


Figure S23 TGA curve of **R(SH)₃** in air.

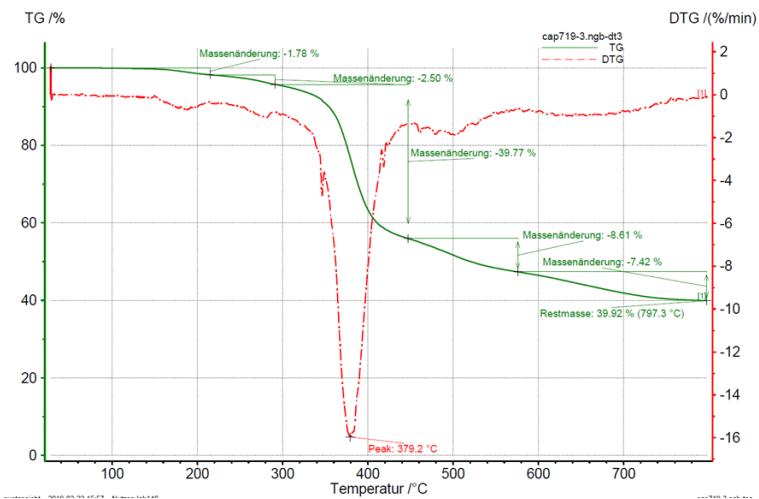


Figure S24 TGA curve of **P5** in air.

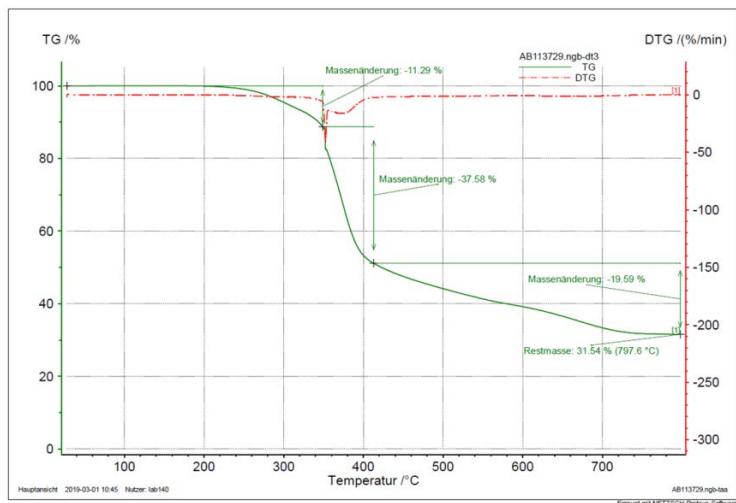


Figure S25 TGA curve of AB113729 in air.

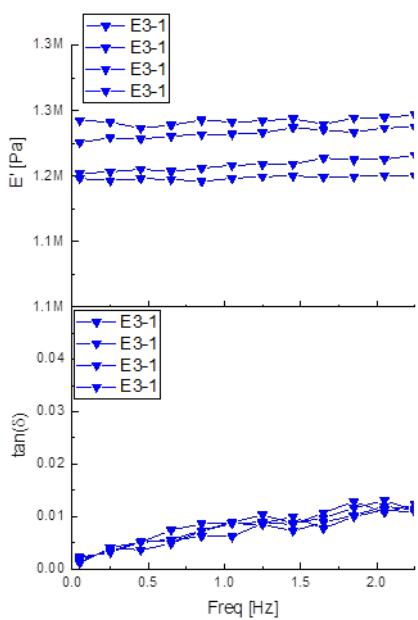


Figure S26 DMA of **E3-1**. Four samples were measured.

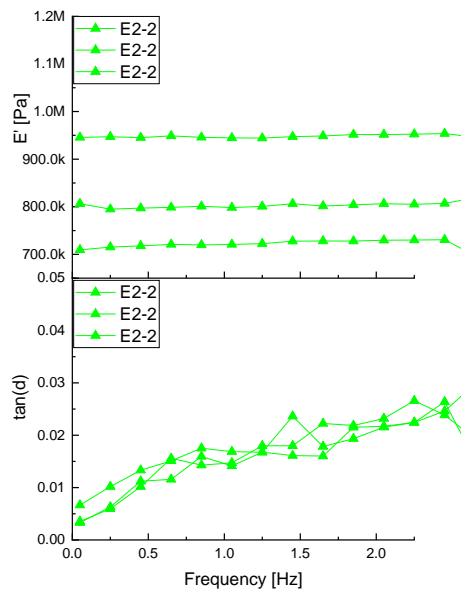


Figure S27 DMA of **E3-2**. Three samples were measured.

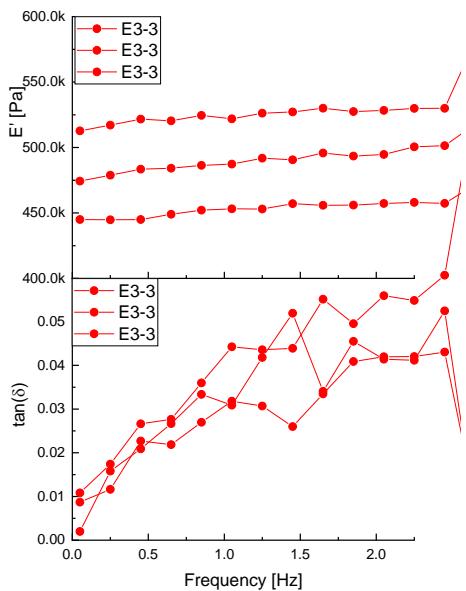


Figure S28 DMA of **E3-3**. Three samples were measured.

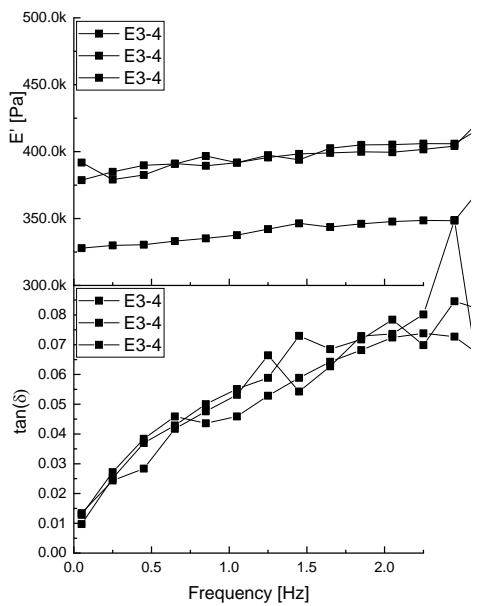


Figure S29 DMA of **E3-4**. Three samples were measured.

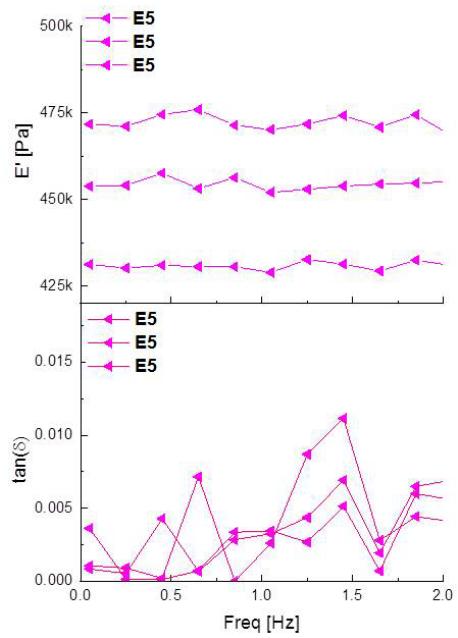


Figure S30 DMA of **E5**. Three samples were measured.

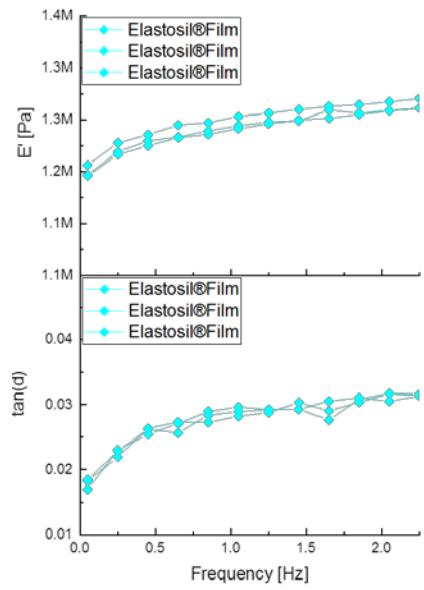


Figure S31 DMA of **Elastosil® Film**. Three samples were measured.

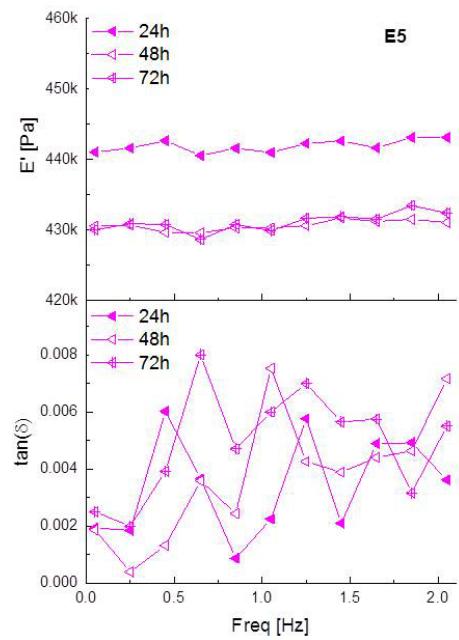


Figure S32 DMA of **E5** measured 24h/48h/72h after synthesis. The average curve of 3 measurements is given. The identical sample was measured.

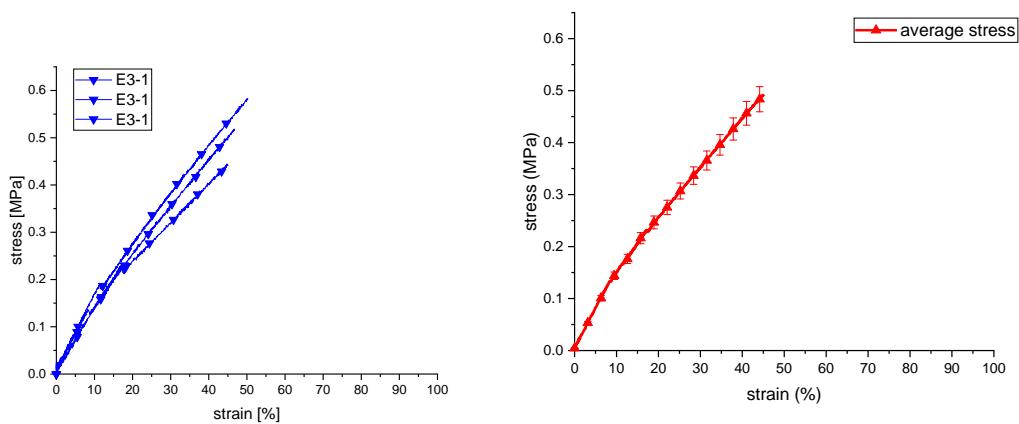


Figure S33 Tensile tests of **E3-1**. Three independent tests were performed.

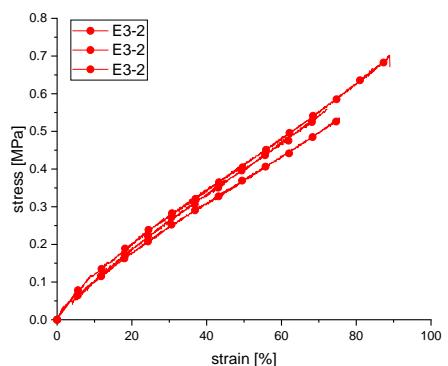


Figure S34 Tensile tests of **E3-2**. Three independent tests were performed.

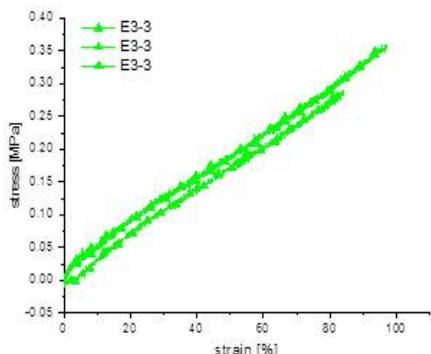


Figure S35 Tensile tests of **E3-3**. Three independent tests were performed.

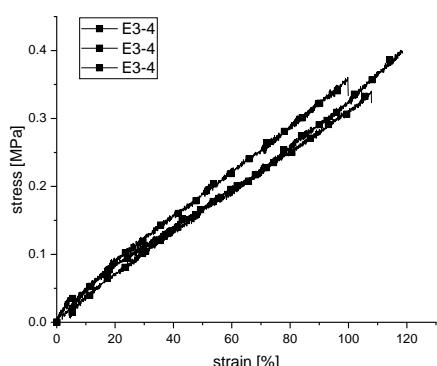


Figure S36 Tensile tests of **E3-4**. Three independent tests were performed.

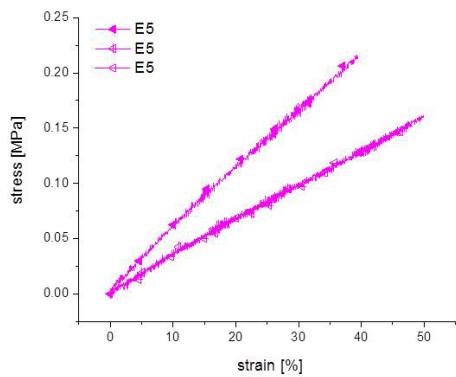


Figure S37 Tensile tests of **E5**. Three independent tests were performed.

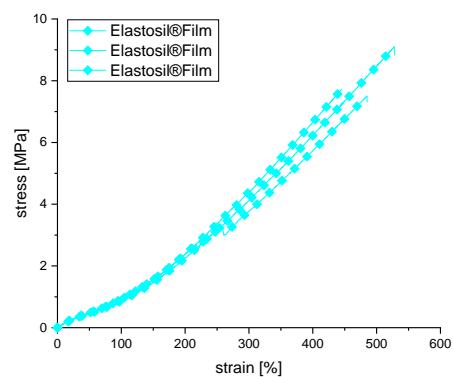


Figure S38 Tensile tests of **Elastosil® Film**. Three independent tests were performed.

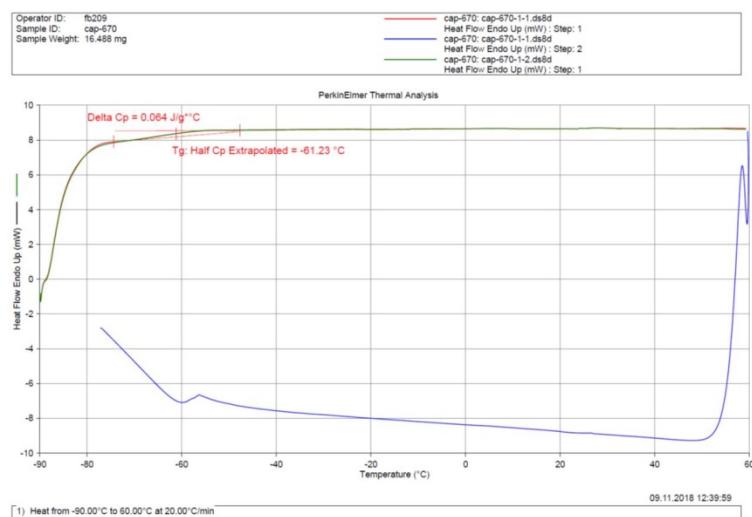


Figure S39 DSC curves of **E3-1**.

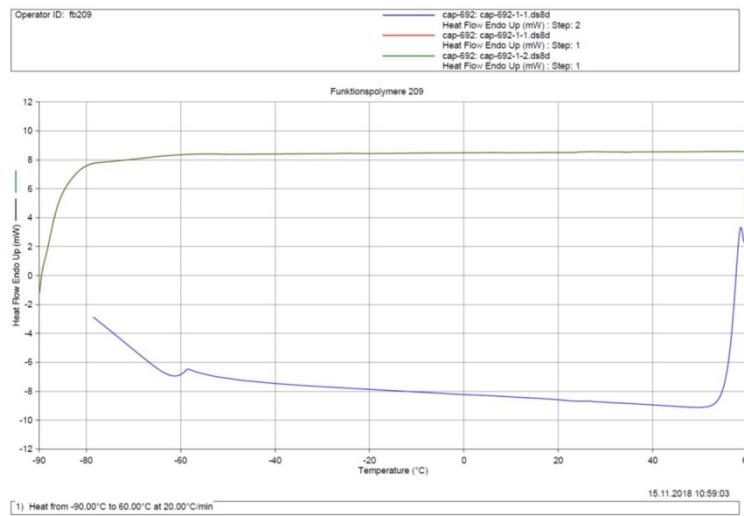


Figure S40 DSC curves of E3-2.

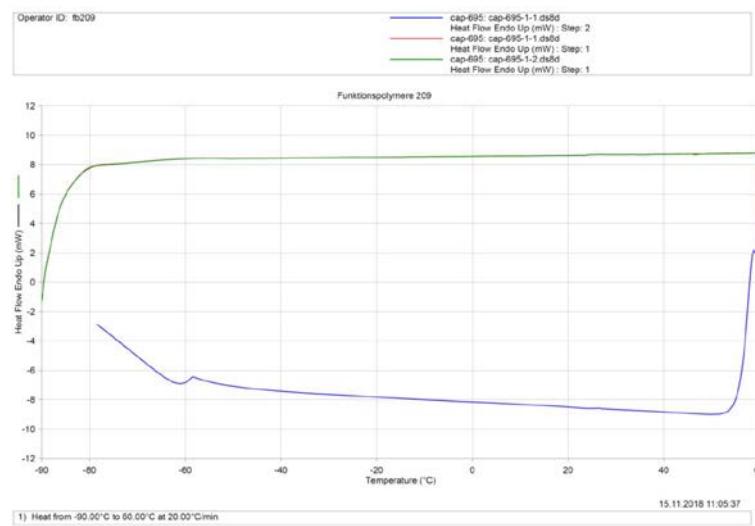


Figure S41 DSC curves of E3-3.

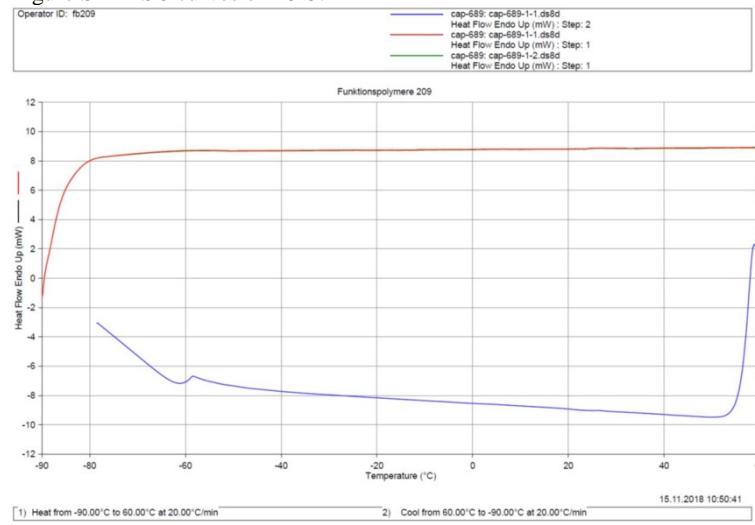


Figure S42 DSC curves of E3-4.

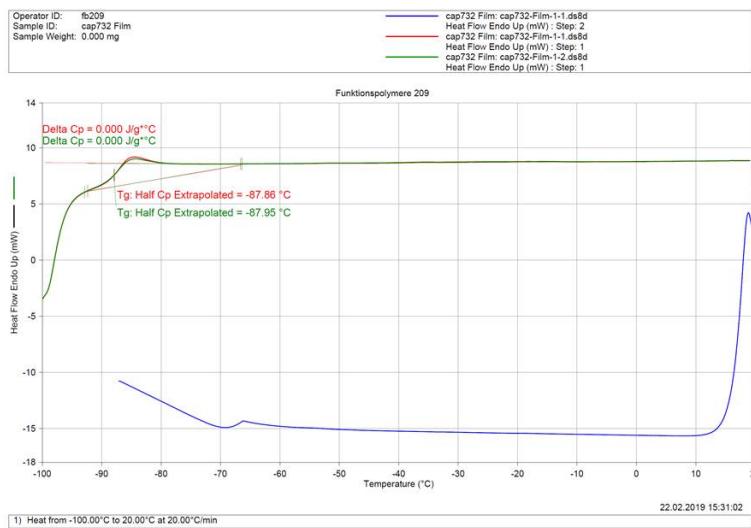


Figure S43 DSC curves of E5.

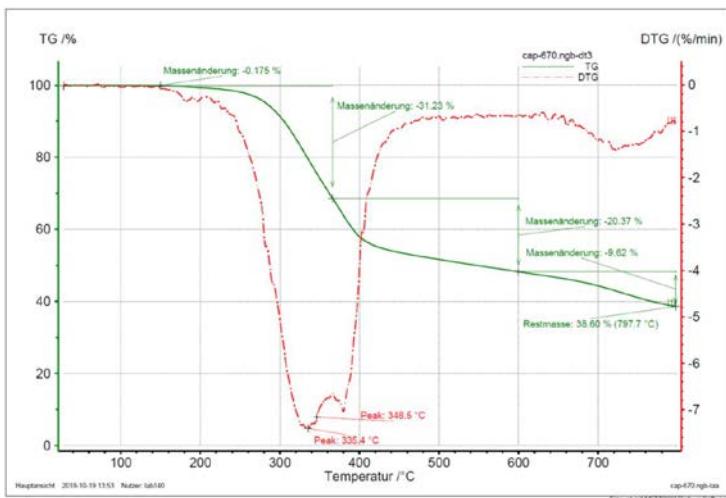


Figure S44 TGA curve of E3-1 in air.

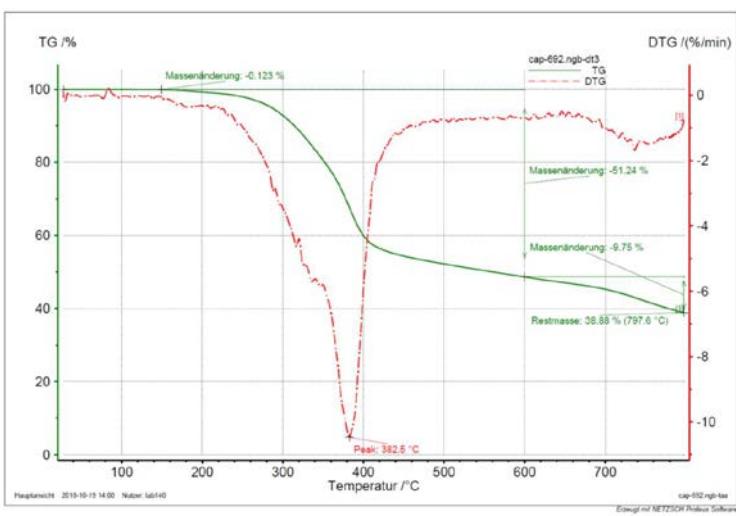


Figure S45 TGA curve of E3-2 in air.

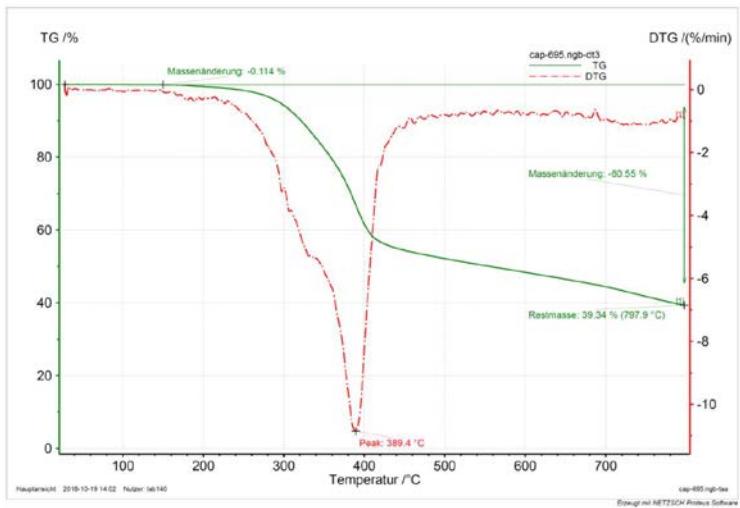


Figure S46 TGA curve of **E3-3** in air.

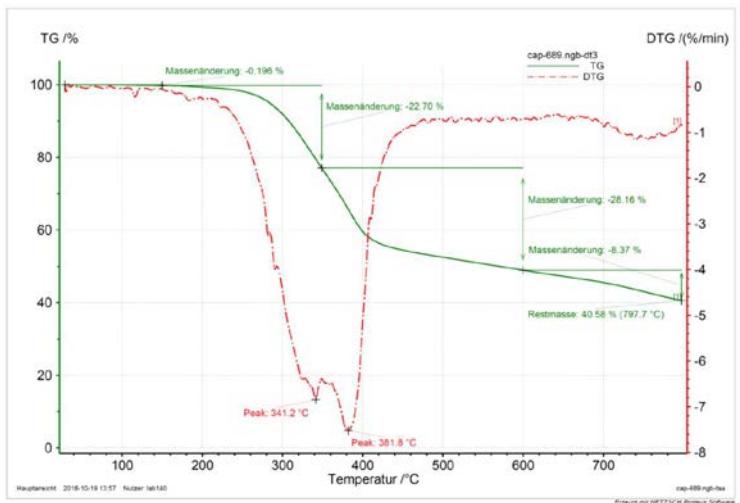


Figure S47 TGA curve of **E3-4** in air.

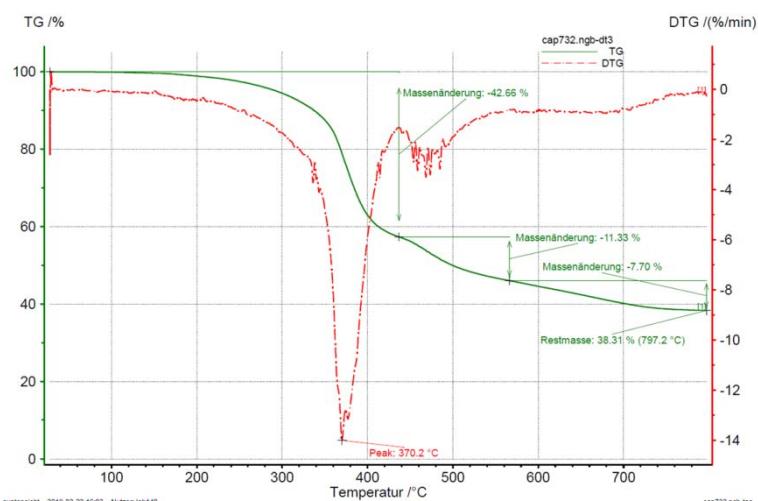


Figure S48 TGA curve of **E5** in air.

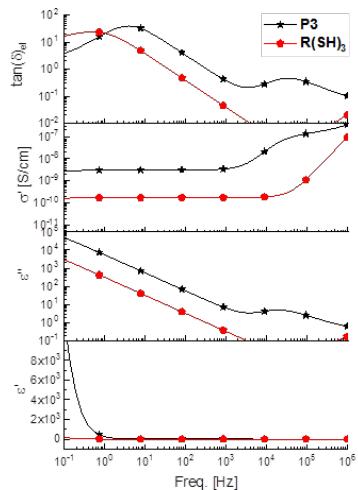


Figure S49 Dielectric properties of **P3** and **R(SH)₃**.

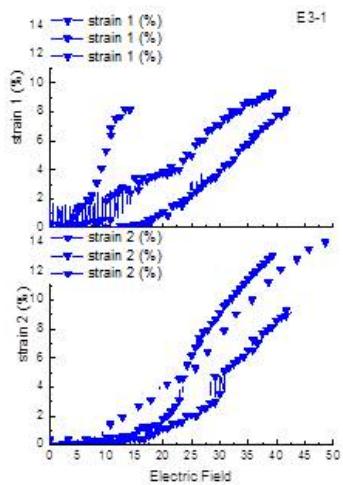


Figure S50 Lateral strain in x-and y-direction (strain 1 and strain 2) of **E3-1** as a function of the applied electric field.

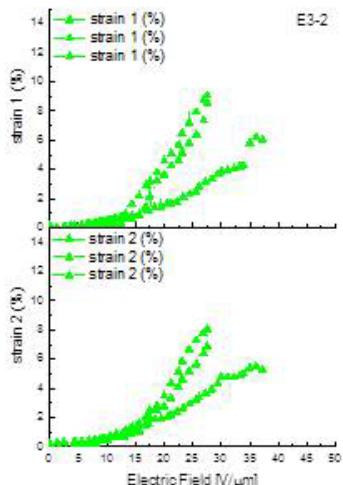


Figure S51 Lateral strain in x-and y-direction (strain 1 and strain 2) of **E3-2** as a function of the applied electric field.

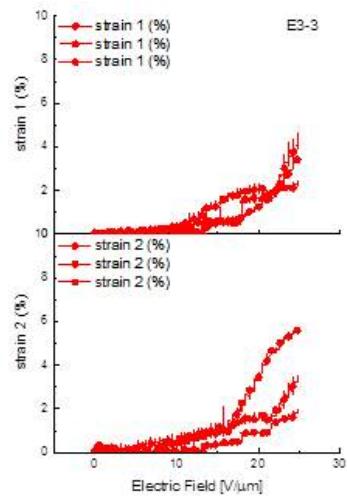


Figure S52 Lateral strain in x-and y-direction (strain 1 and strain 2) of **E3-3** as a function of the applied electric field.

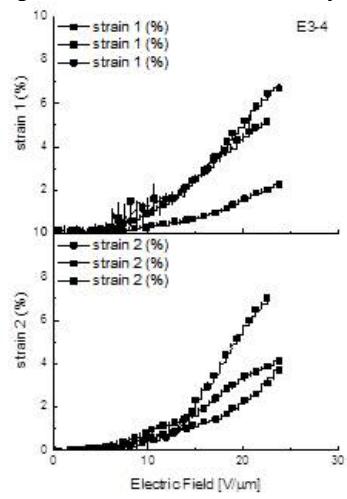


Figure S53 Lateral strain in x-and y-direction (strain 1 and strain 2) of **E3-4** as a function of the applied electric field.

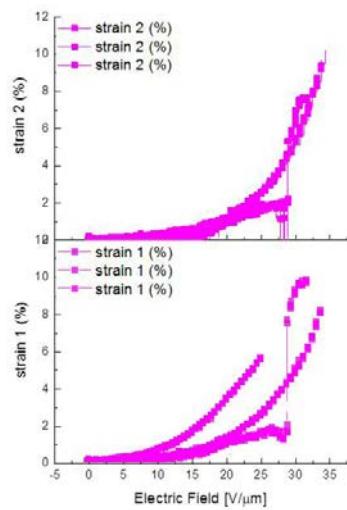


Figure S54 Lateral strain in x-and y-direction (strain 1 and strain 2) of **E3-4** as a function of the applied electric field.

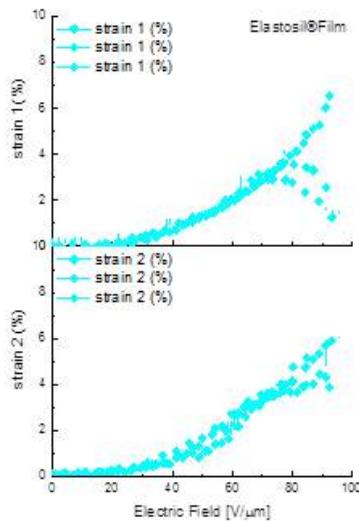


Figure S55 Lateral strain in x-and y-direction (strain 1 and strain 2) of **Elastosil®Film** as a function of the applied electric field.

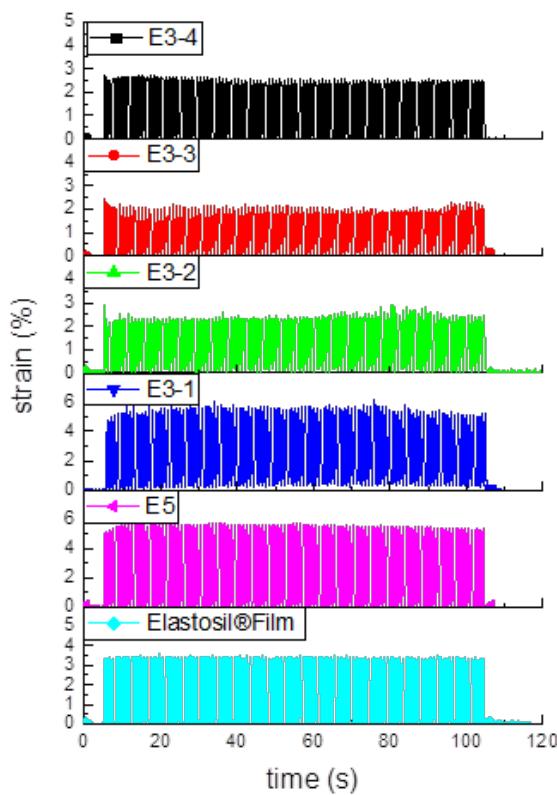


Figure S56 Average lateral strain of E3-Y and **Elastosil®Film** as a function of the applied electric field (DC) operated at 1 Hz. The electric field was 80 V/ μ m for **Elastosil®Film**, 30 V/ μ m for **E3-1**, 25 V/ μ m for **E3-2/E3-3**, and 20 V/ μ m for **E3-4**.

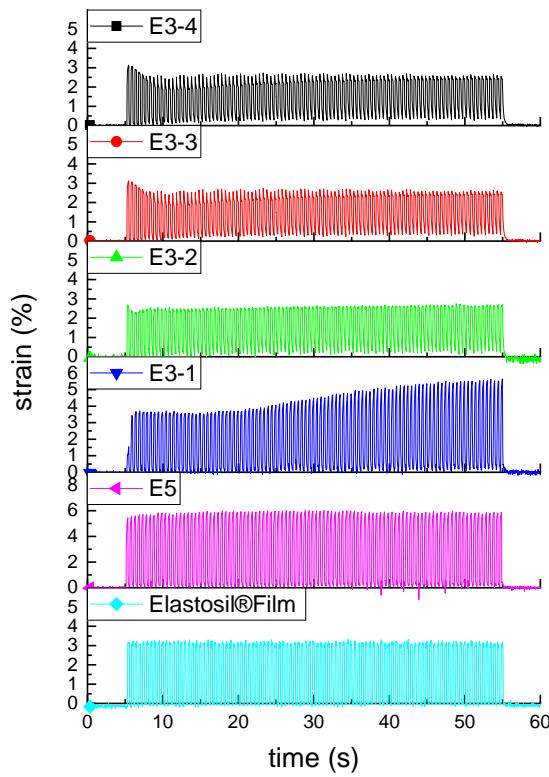


Figure S57 Average lateral strain of E3-Y and Elastosil®Film as a function of the applied electric field (DC) operated at 2 Hz. The electric field was 80 V/ μ m for Elastosil®Film, 30 V/ μ m for E3-1, 25 V/ μ m for E3-2/E3-3, and 20 V/ μ m for E3-4.

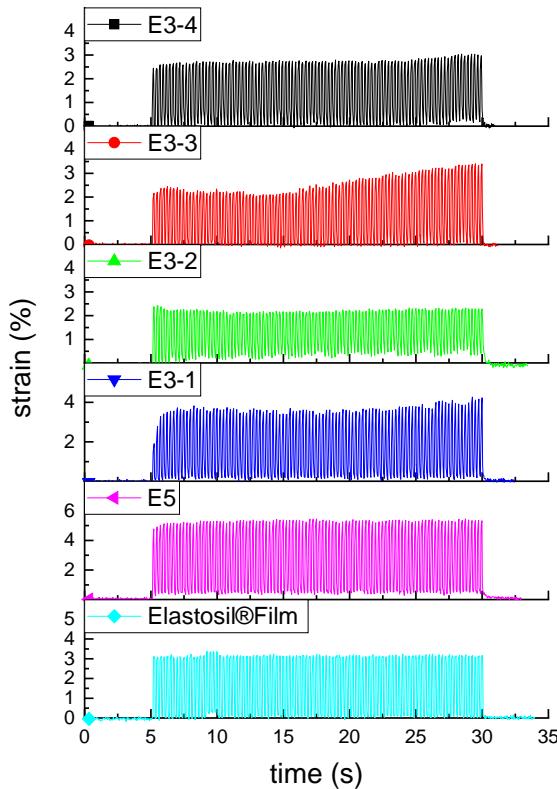


Figure S58 Average lateral strain of E3-Y and Elastosil®Film as a function of the applied electric field (DC) operated at 4 Hz. The electric field was 80 V/ μ m for Elastosil®Film, 30 V/ μ m for E3-1, 25 V/ μ m for E3-2/E3-3, and 20 V/ μ m for E3-4.

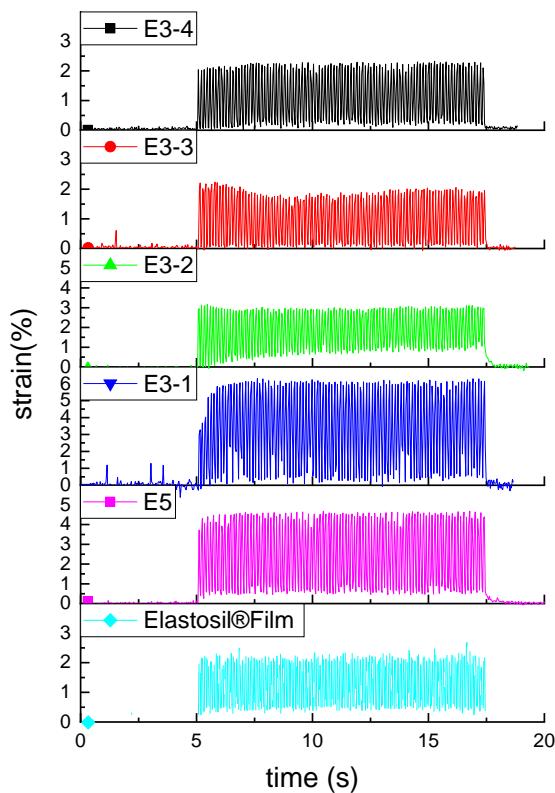


Figure S59 Average lateral strain of **E3-Y** and **Elastosil@Film** as a function of the applied electric field (DC) operated at 8 Hz. The electric field was 80 V/ μ m for **Elastosil@Film**, 30 V/ μ m for **E3-1**, 25 V/ μ m for **E3-2/E3-3**, and 20 V/ μ m for **E3-4**.

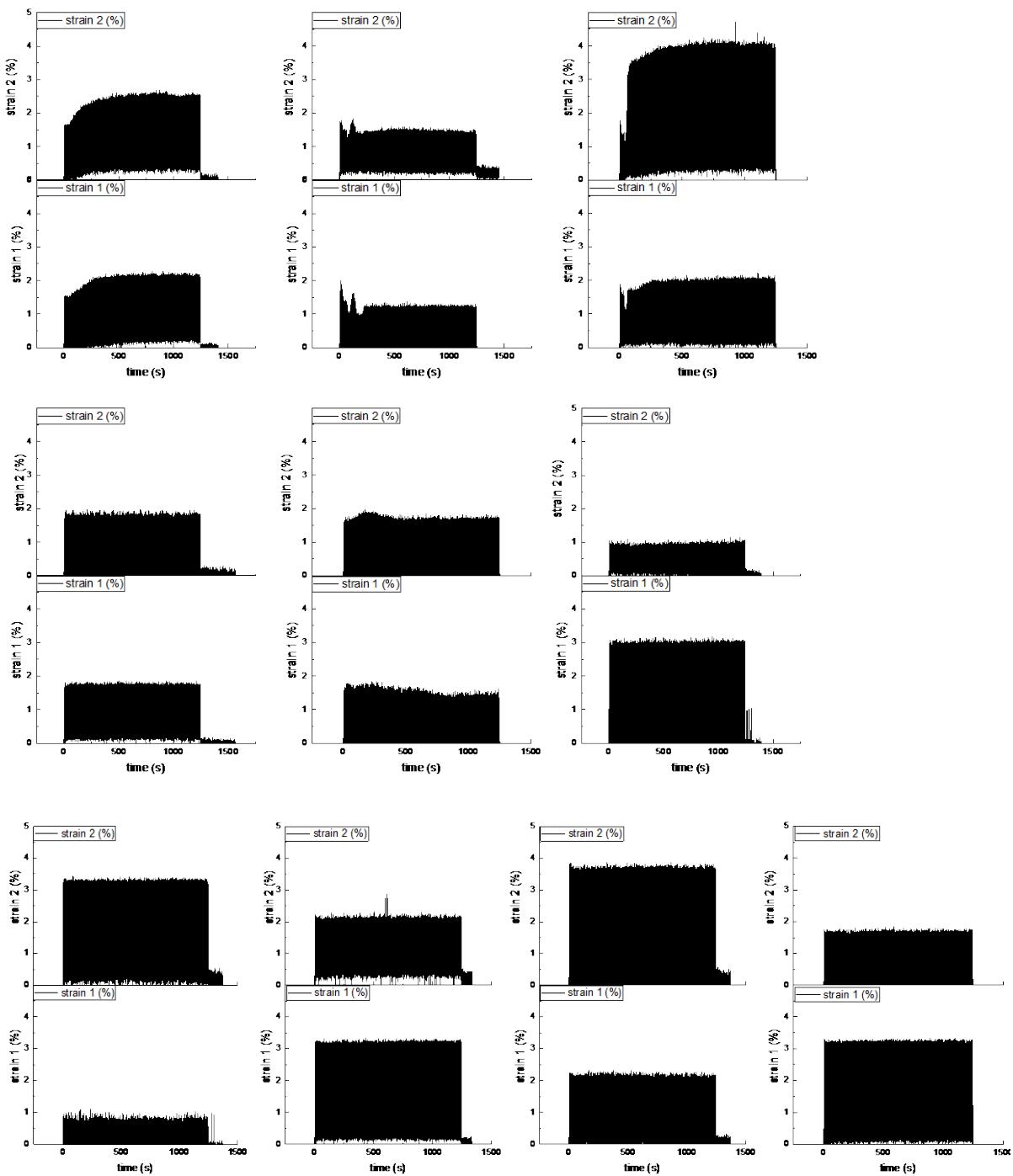


Figure S60 10 x 10.000 operation cycles at 8 Hz at 25 V/ μ m of a circular DEA test device constructed from a 75 μ m-thin film of E3-1 with an area diameter of 8 mm. Strain 1 is defined as the lateral strain in x-direction. Strain 2 is defined as the lateral strain in y-direction.

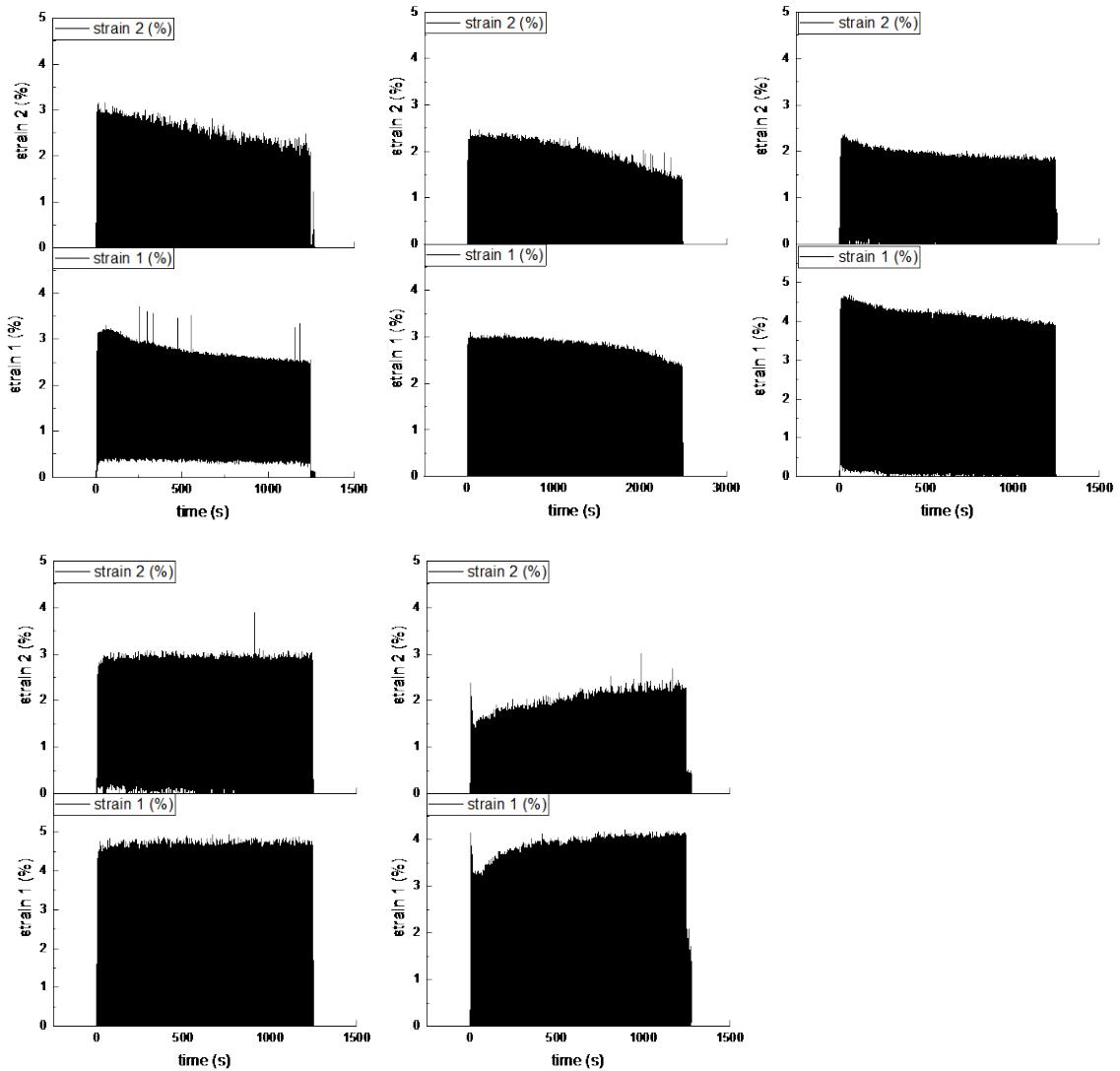


Figure S61 5 x 10.000 operation cycles + 1 x 20.000 at 8 Hz at 29 V/ μ m of a circular DEA test device constructed from a 85 μ m-thin film of E3-2 with an area diameter of 8 mm. Strain 1 is defined as the lateral strain in x-direction. Strain 2 is defined as the lateral strain in y-direction.

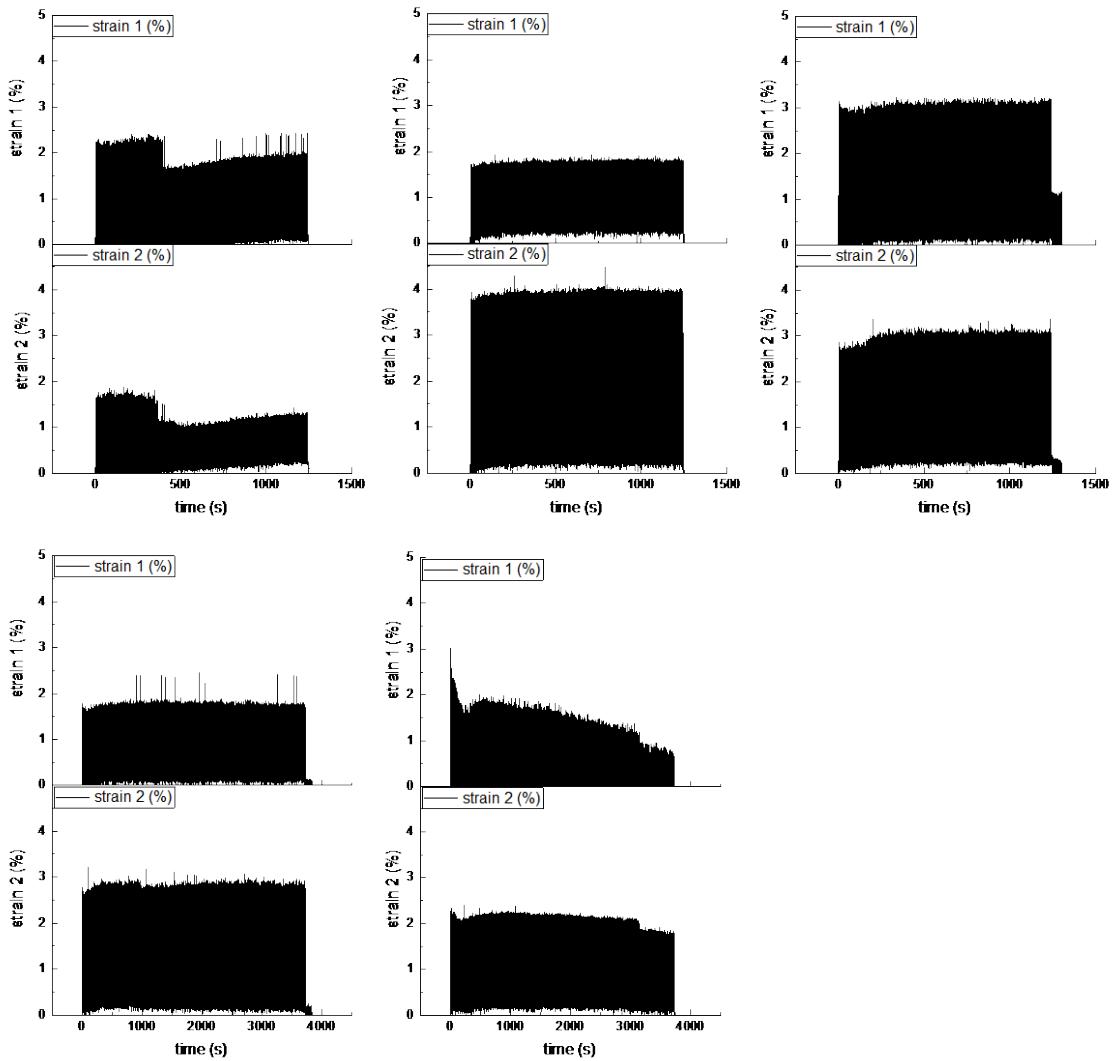


Figure S62 3 x 10.000 + 2 x 30.0000 DEA operation cycles at 8 Hz at 25 V/ μ m of a circular DEA test device constructed from a 90 μ m-thin film of E3-3 with an area diameter of 8 mm. Strain 1 is defined as the lateral strain in x-direction. Strain 2 is defined as the lateral strain in y-direction.

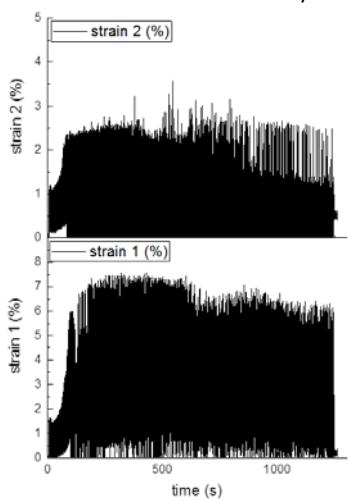


Figure S63 1 x 10,000 DEA operation cycles at 8 Hz at 15 V/ μ m of a circular DEA test device constructed from a 100 μ m-thin film of **E3-4** with an area diameter of 8 mm. Strain 1 is defined as the lateral strain in x-direction. Strain 2 is defined as the lateral strain in y-direction.

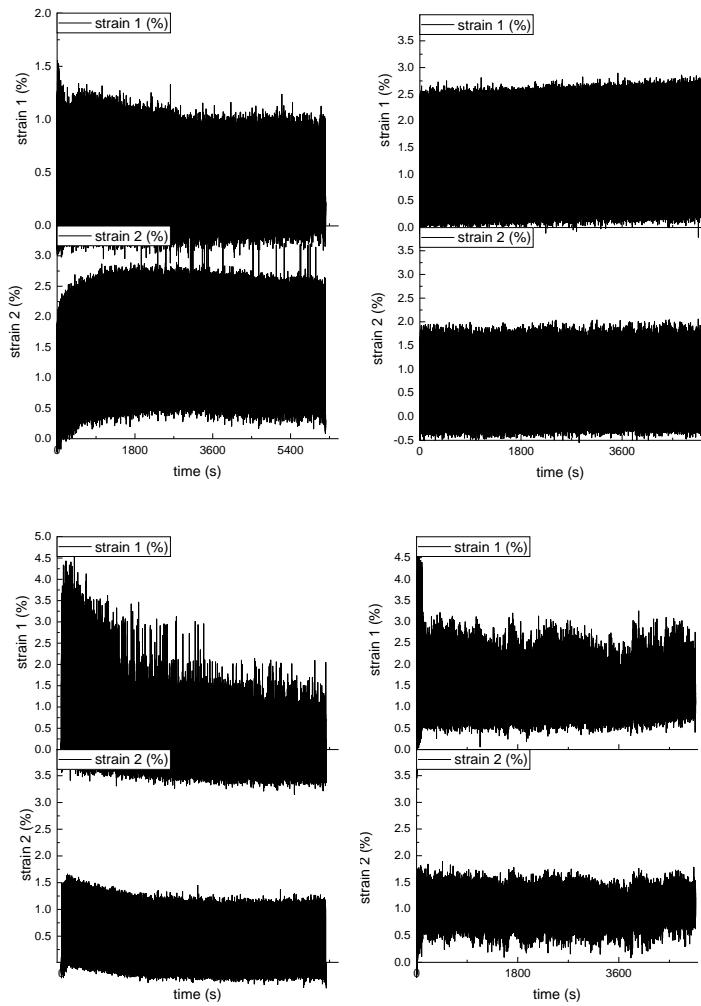


Figure S64 2 x 50.000 and 2 x 40.000 DEA operation cycles at 8 Hz at 25 V/ μ m of a circular DEA test device constructed from a 85 μ m-thin film of **E5** with an area diameter of 8 mm. Strain 1 is defined as the lateral strain in x-direction. Strain 2 is defined as the lateral strain in y-direction.