Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Supporting Information

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

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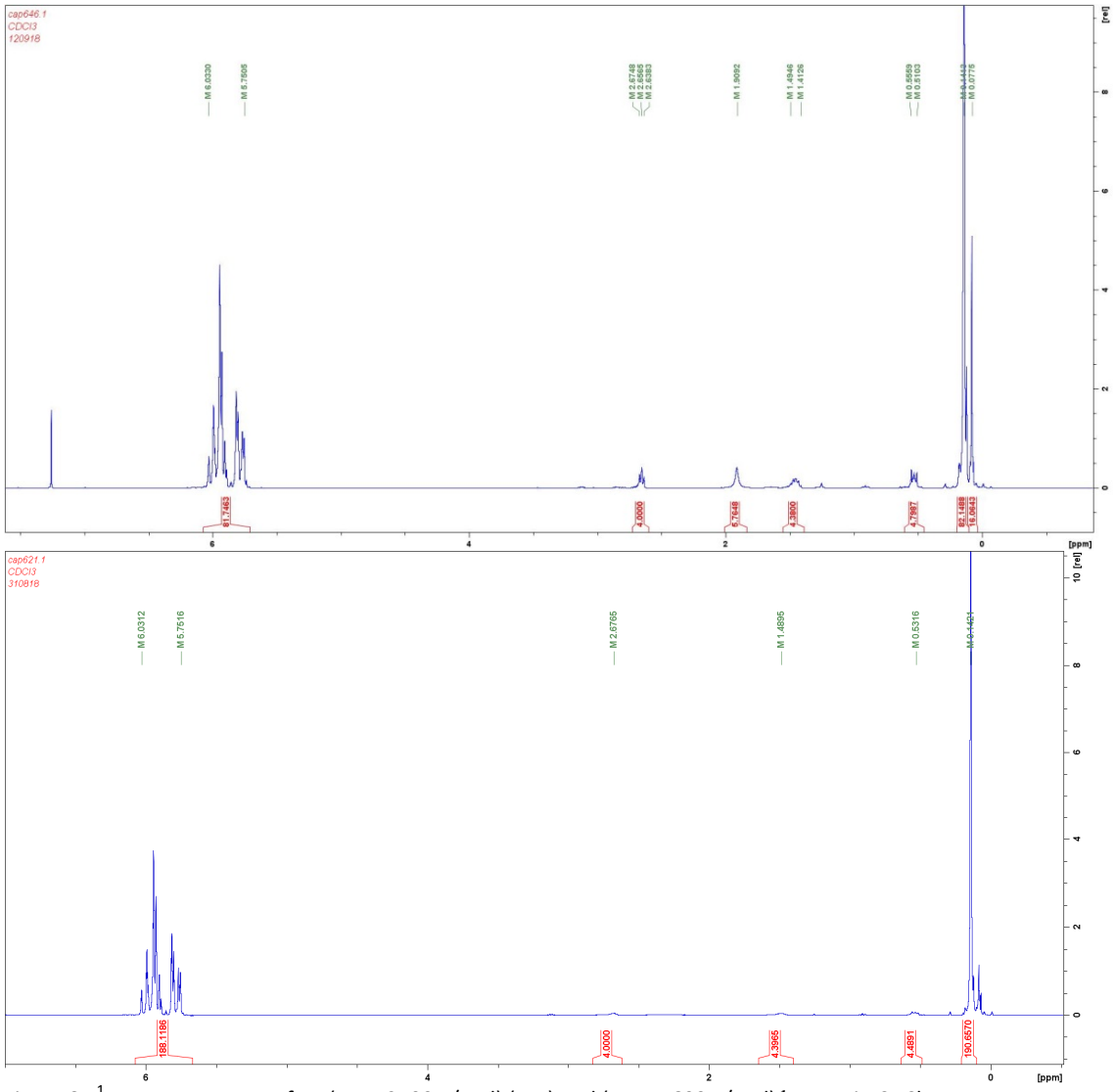

Figure S1 ^{1}H NMR spectrum of **P1** (M_n = 2500 g/mol) (top) and (M_n = 5600 g/mol) bottom in $CDCl_3$.

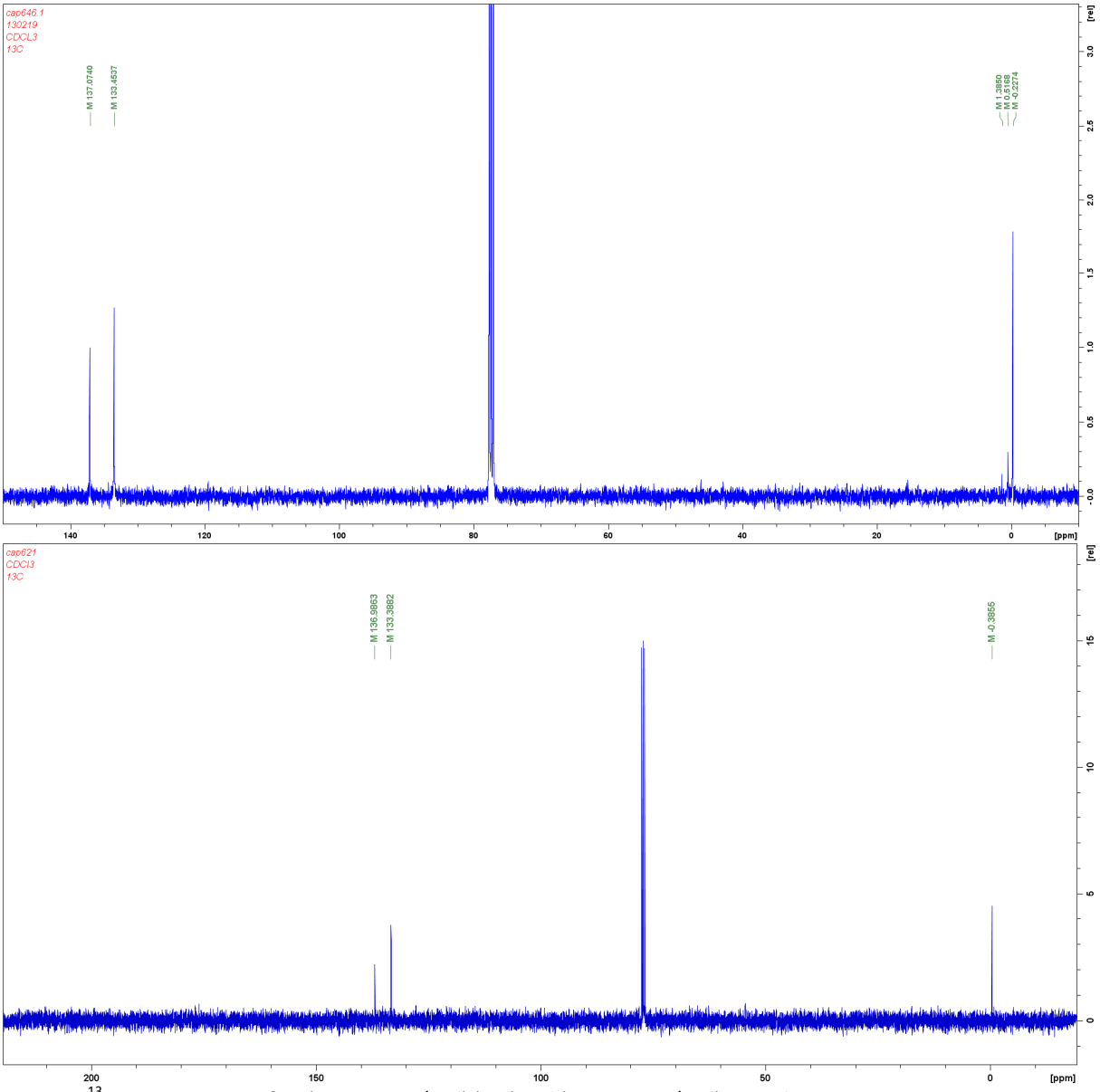

Figure S2 ^{13}C NMR spectrum of **P1** (M_n = 2500 g/mol) (top) and (M_n = 5600 g/mol) in $CDCl_3$.

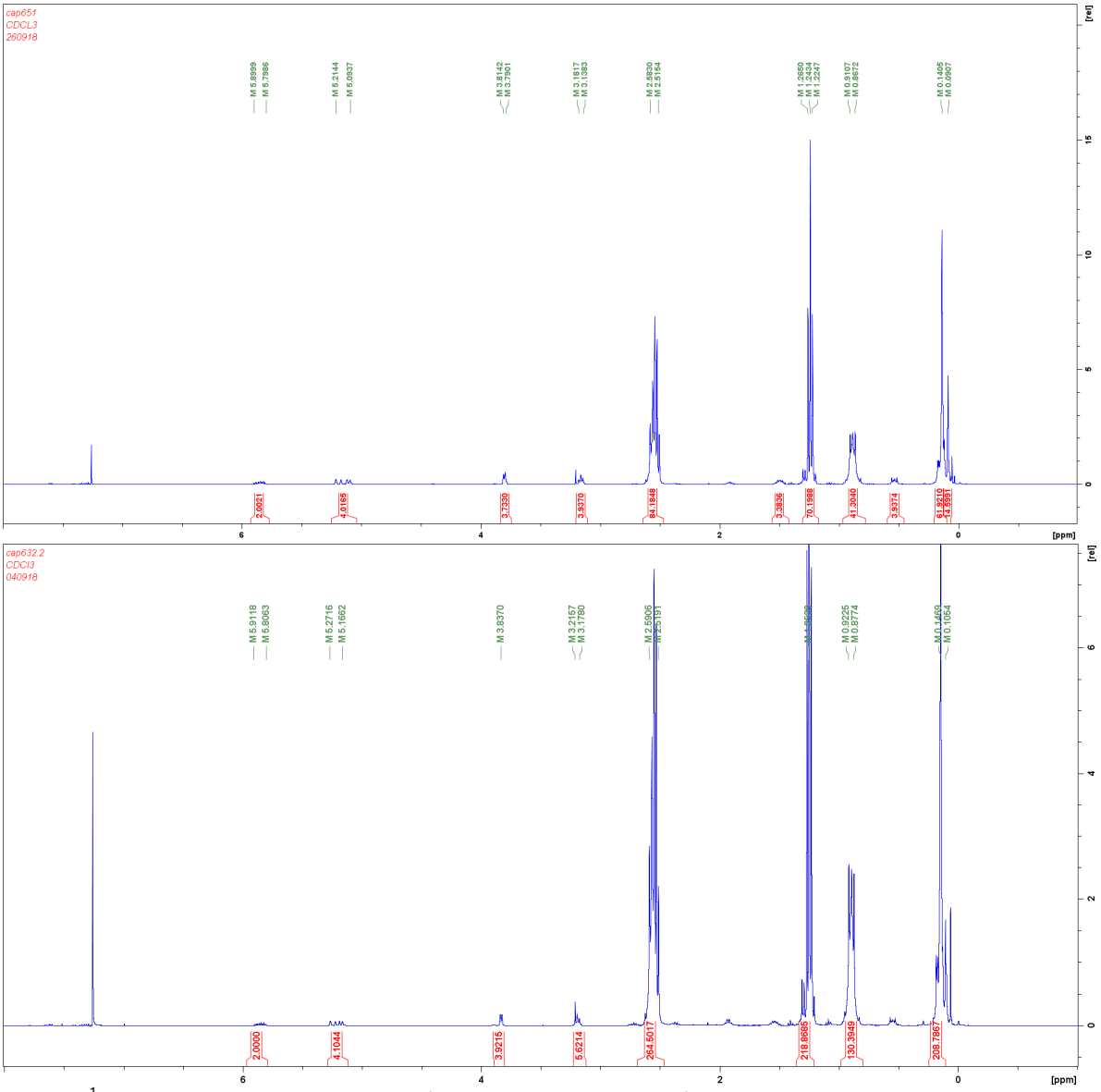

Figure S3 ^{1}H NMR spectrum of **P3** (M_n = 3500 g/mol (top) and M_n = 10000 g/mol) in $CDCl_3$.

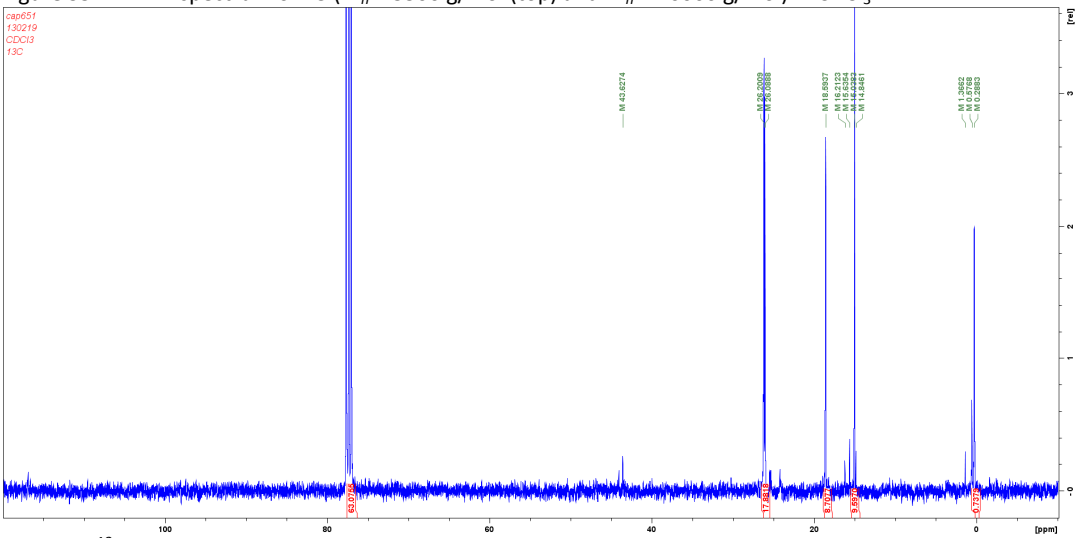

Figure S4 ^{13}C NMR spectrum of **P3** (M_n = 3500 g/mol) in $CDCl_3$.

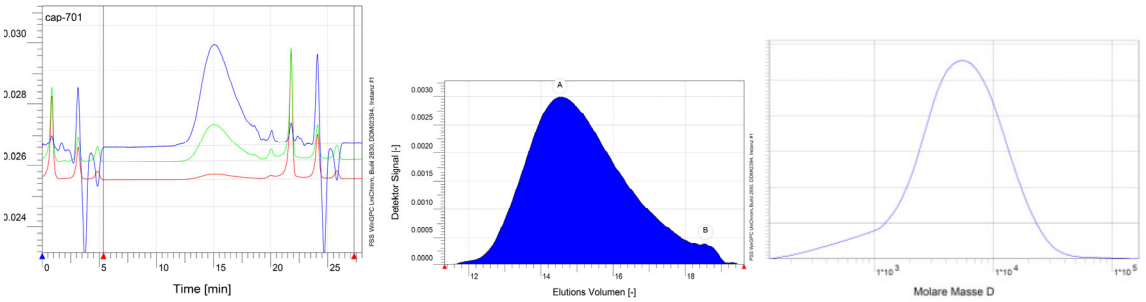

Figure S5 GPC elution curves of **P3**. M_n= 3000, M_w = 7000, PDI = 2.4.

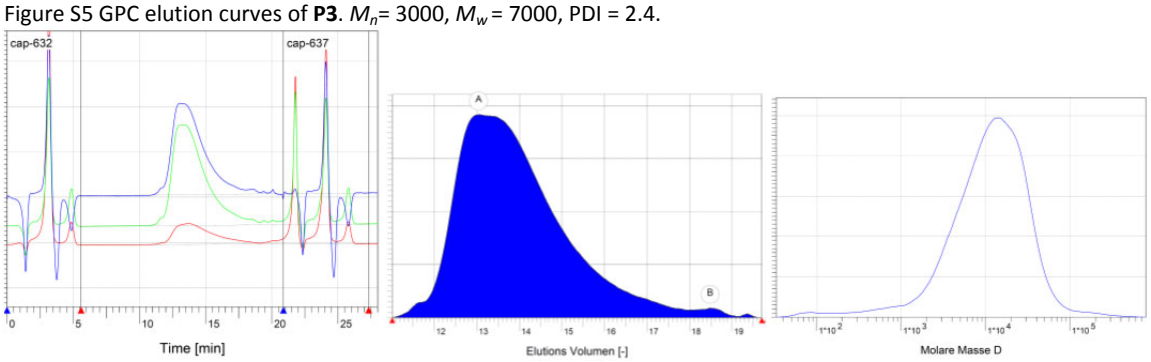

Figure S6 GPC elution curves of **P3.2**. M_n=3000, M_w= 18000, PDI= 5.5

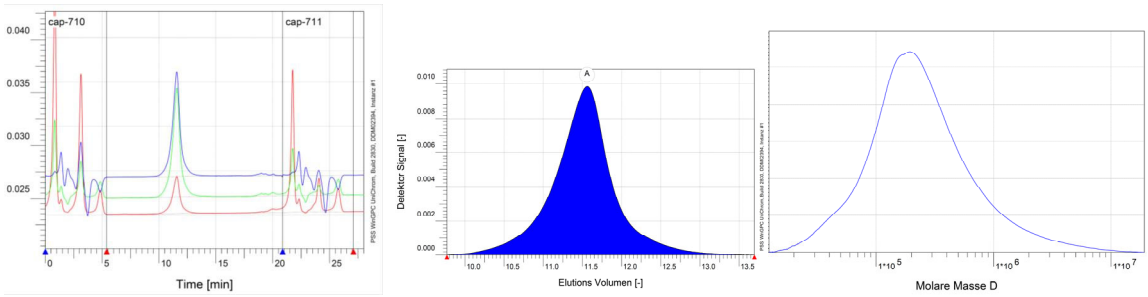

Figure S7 GPC elution curves of **P4**. M_n= 150.000, M_w= 450.000, PDI= 2.4.

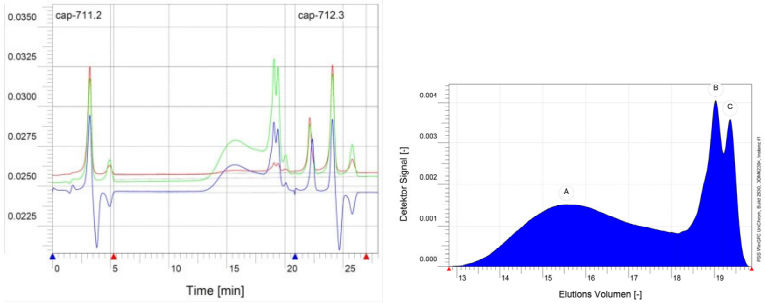

Figure S8 GPC elution curves of the depolymerization of **P4** under basic conditions.

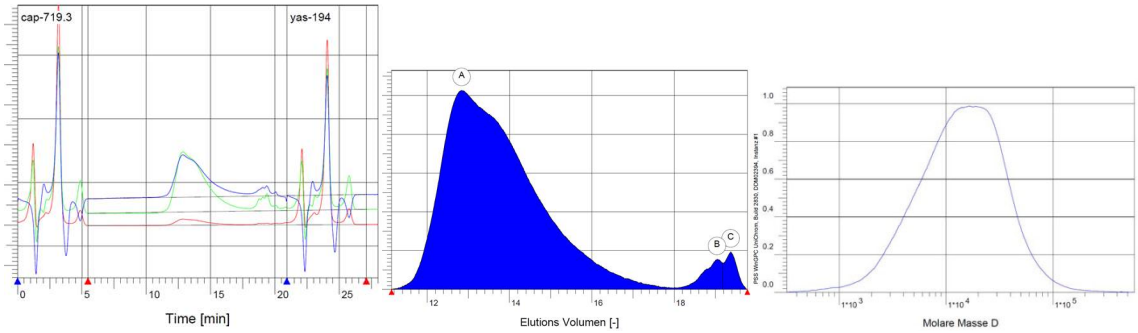

Figure S9 GPC elution curves of **P5**. M_n= 8500, M_w= 20000, *PDI* = 2.4.

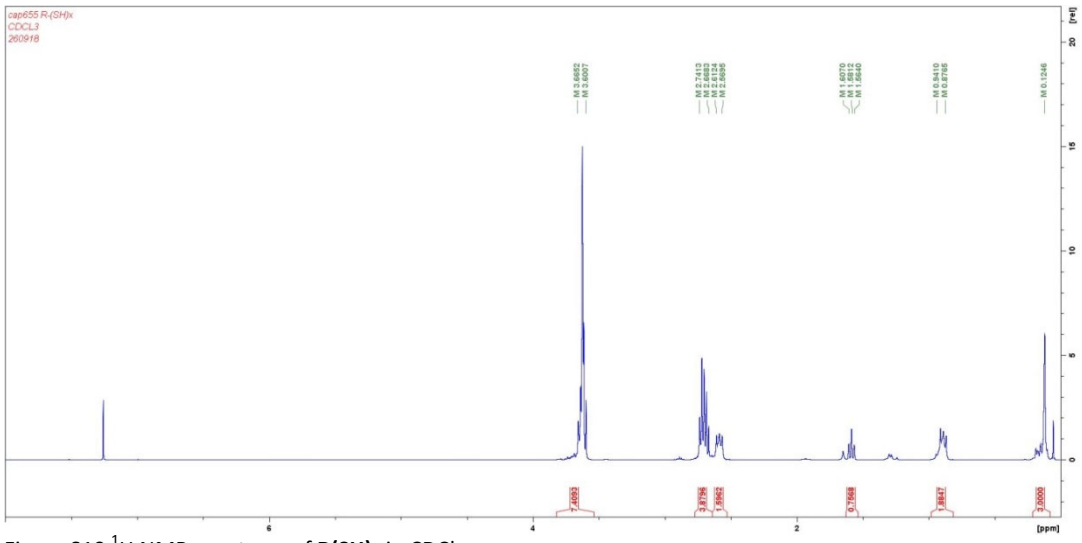

Figure S10 ^{1}H NMR spectrum of **R(SH)$_3$** in $CDCl_3$.

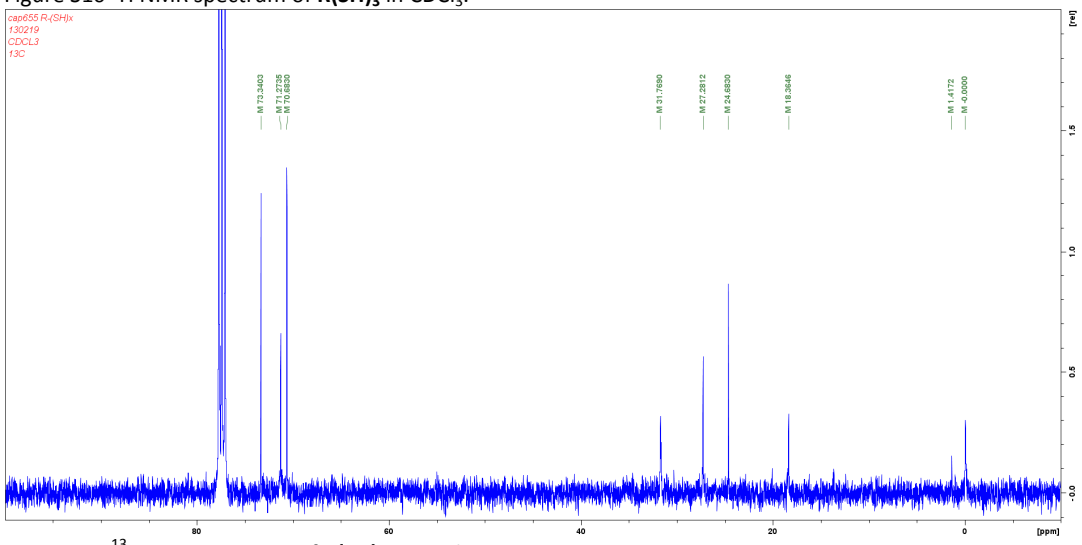

Figure S11 ^{13}C NMR spectrum of **R(SH)$_3$** in $CDCl_3$.

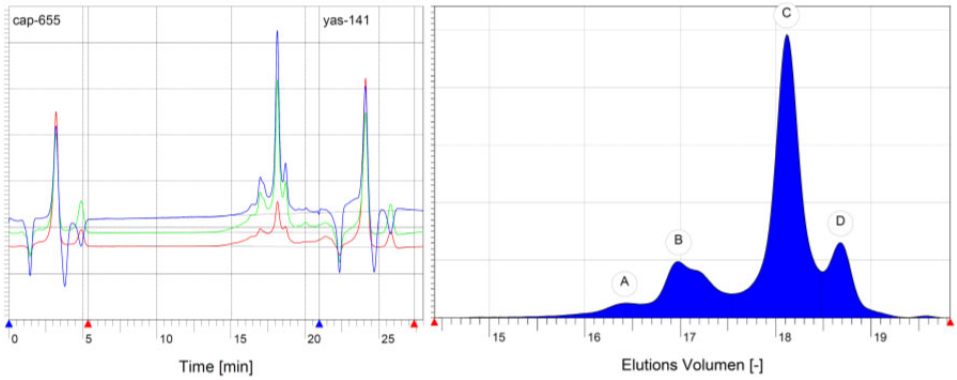

Figure S12 GPC elution curves of **R(SH)$_3$**.

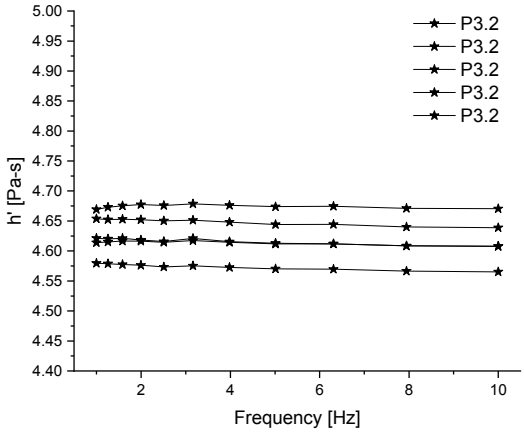

Figure S13 Viscosity of **P3.2** measured in the frequency range of 1-10 Hz. Five measurements were performed.

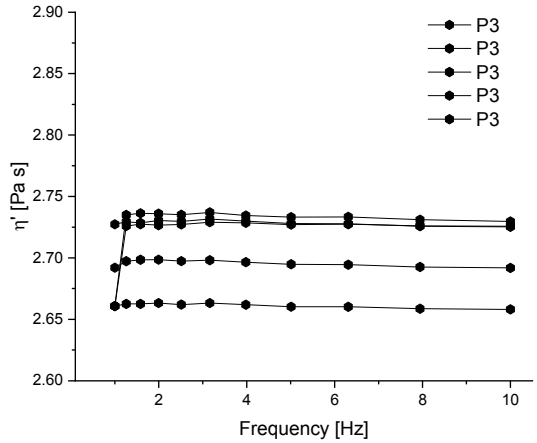

Figure S14 Viscosity of **P3** measured in the frequency range of 1-10 Hz. Five measurements were performed.

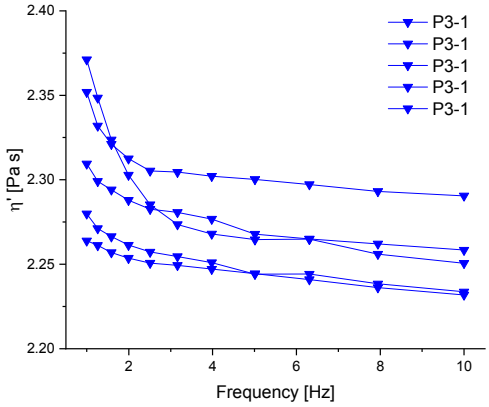

Figure S15 Viscosity of **P3-1** measured in the frequency range of 1-10 Hz. Five measurements were performed.

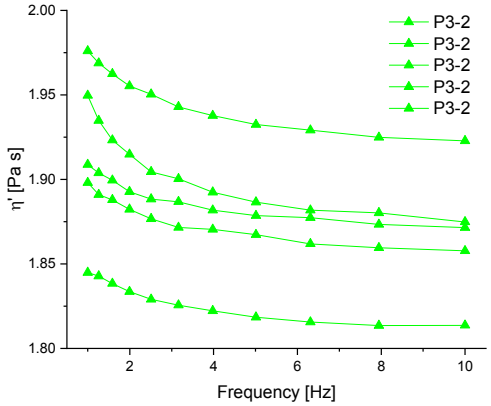

Figure S16 Viscosity of **P3-2** measured in the frequency range of 1-10 Hz. Five measurements were performed.

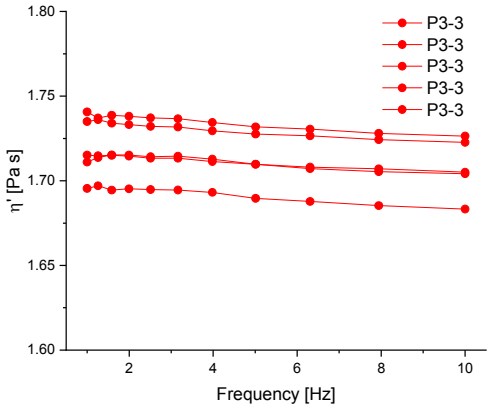

Figure S17 Viscosity of **P3-3** measured in the frequency range of 1-10 Hz. Five measurements were performed.

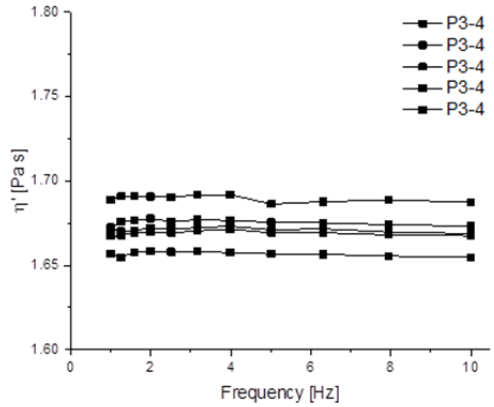

Figure S18 Viscosity of **P3-4** measured in the frequency range of 1-10 Hz. Five measurements were performed.

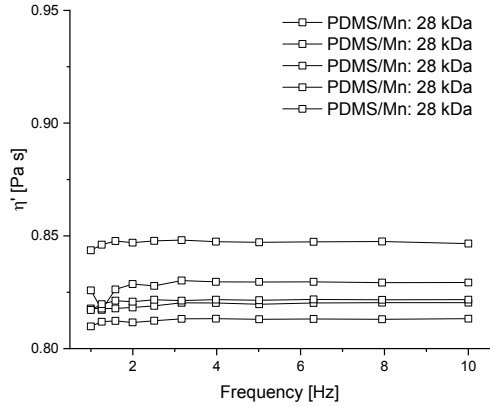

Figure S19 Viscosity of α'ω-OH-PDMS (M_n = 28 kDa) measured in the frequency range of 1-10 Hz. Five measurements were performed.

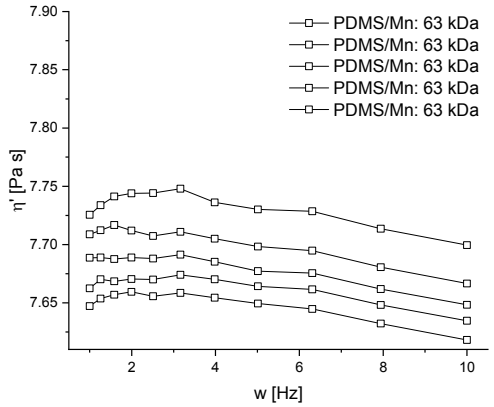

Figure S20 Viscosity of α'ω-OH-PDMS (M_n = 63 kDa) measured in the frequency range of 1-10 Hz. Five measurements were performed.

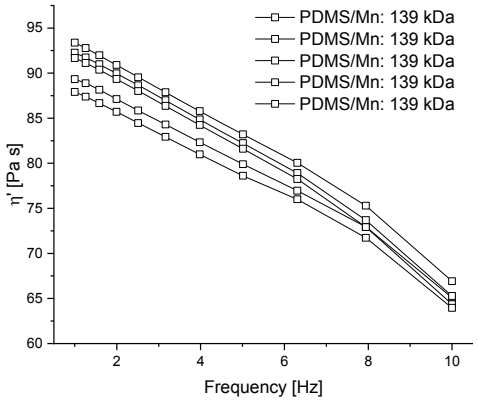

Figure S21 Viscosity of α'ω-OH-PDMS (M_n = 139 kDa) measured in the frequency range of 1-10 Hz. Five measurements were performed.

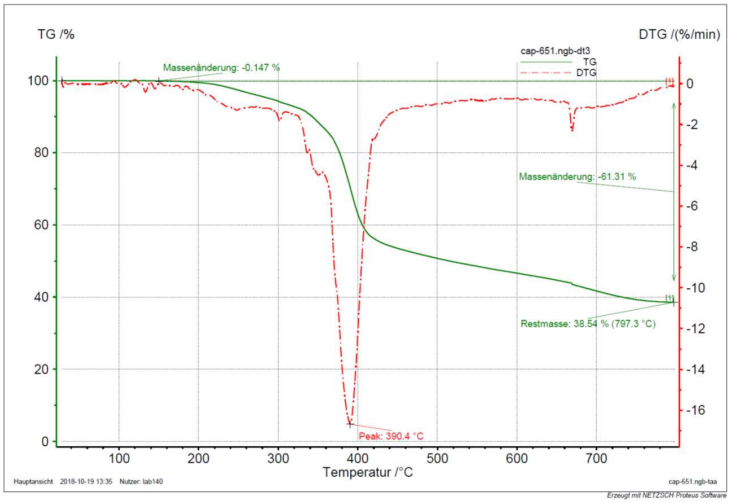

Figure S22 TGA curve of **P3** in air.

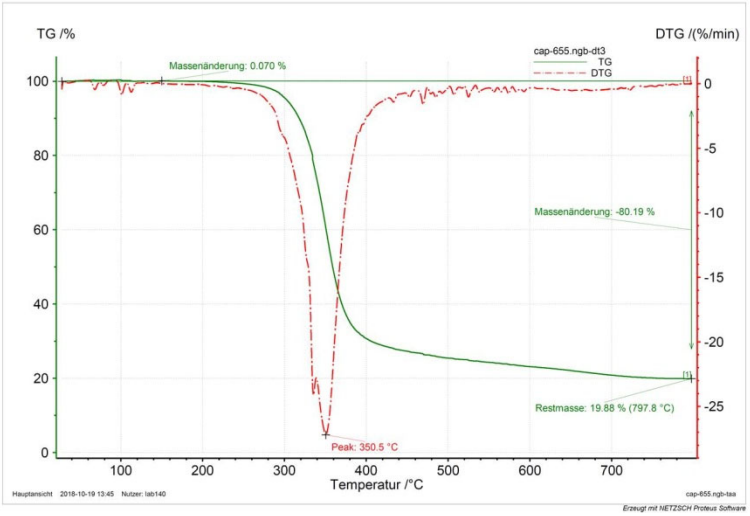

Figure S23 TGA curve of **R(SH)$_3$** in air.

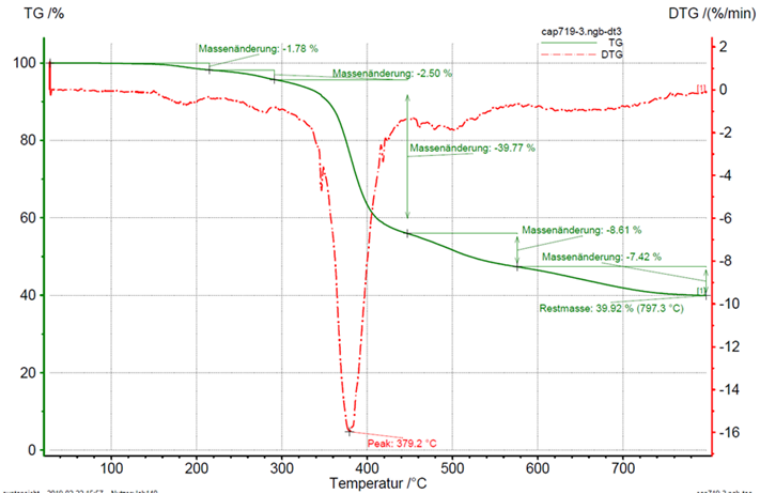

Figure S24 TGA curve of **P5** in air.

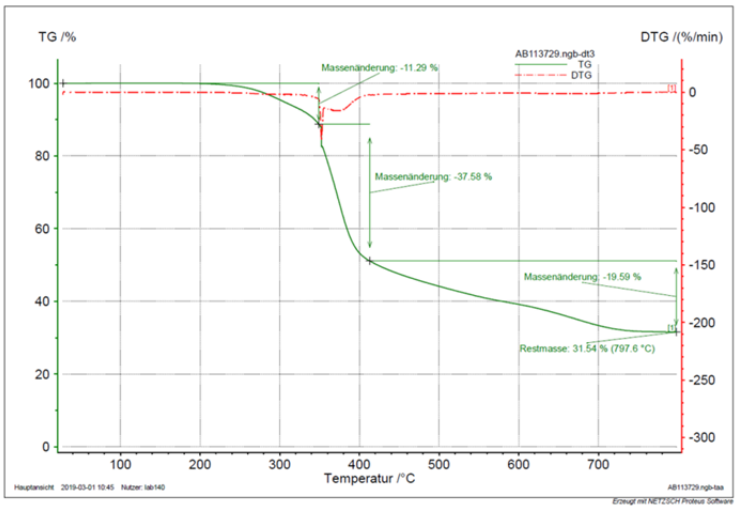

Figure S25 TGA curve of *AB113729* in air.

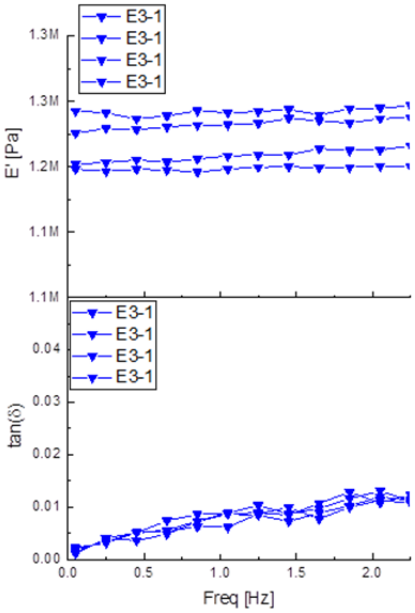

Figure S26 DMA of **E3-1**. Four samples were measured.

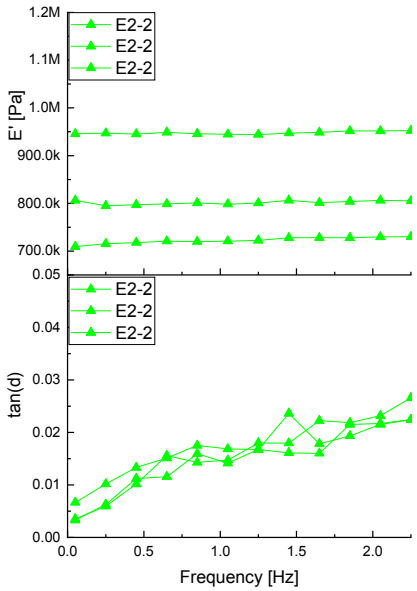

Figure S27 DMA of **E3-2**. Three samples were measured.

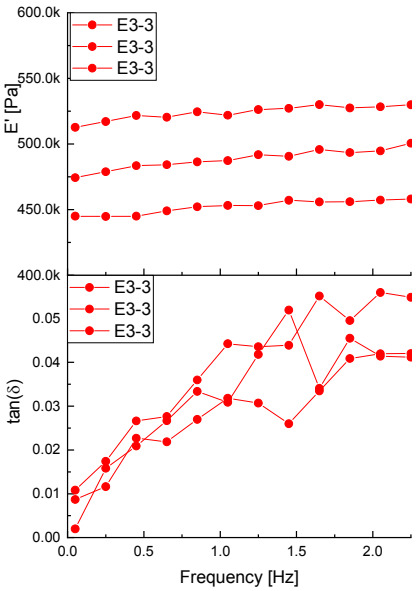

Figure S28 DMA of **E3-3**. Three samples were measured.

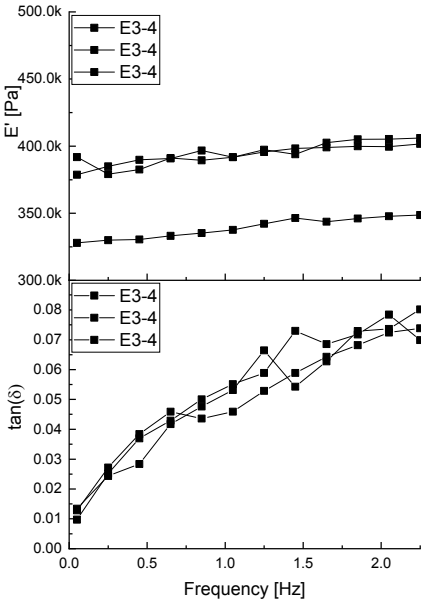

Figure S29 DMA of **E3-4**. Three samples were measured.

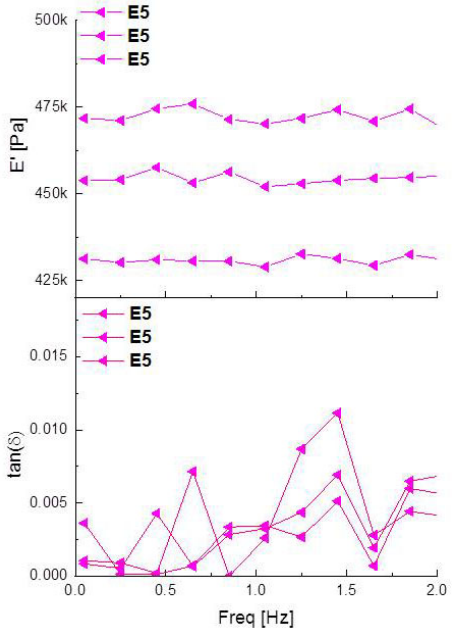

Figure S30 DMA of **E5**. Three samples were measured.

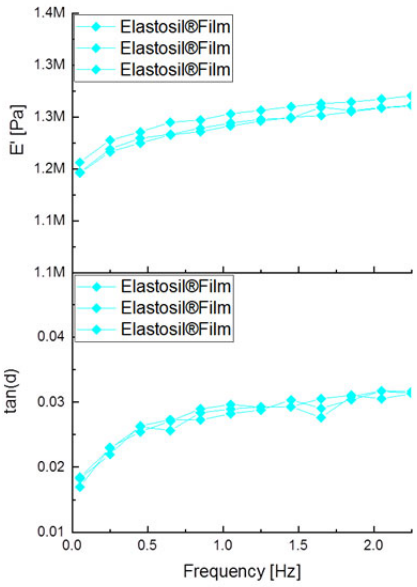

Figure S31 DMA of **Elastosil®Film**. Three samples were measured.

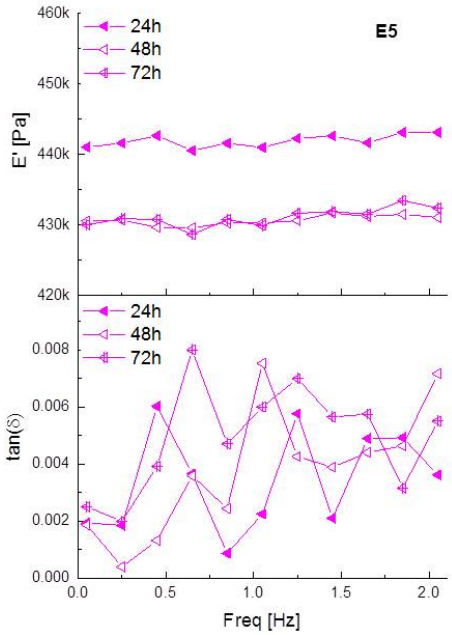

Figure S32 DMA of **E5** measured 24h/48h/72h after synthesis. The average curve of 3 measurements is given. The identical sample was measured.

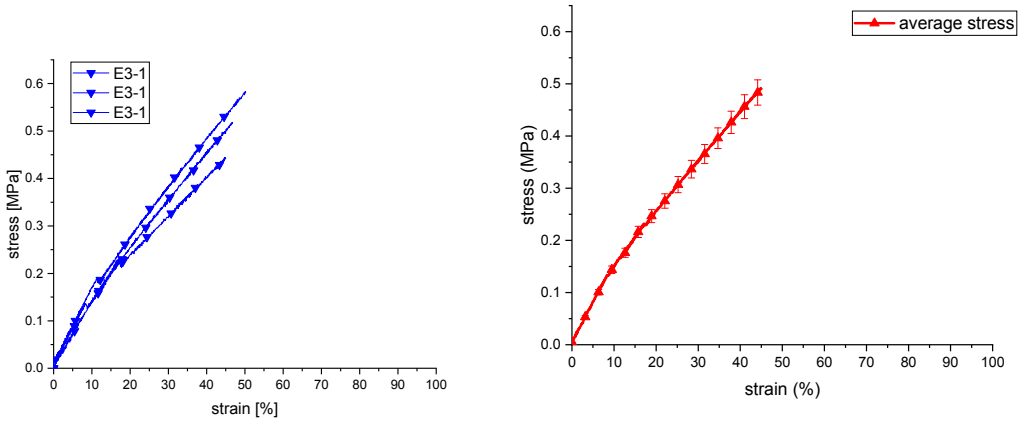

Figure S33 Tensile tests of **E3-1**. Three independent tests were performed.

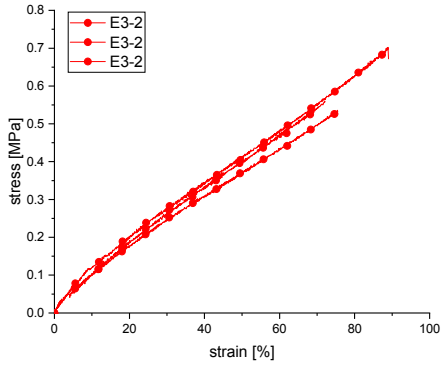

Figure S34 Tensile tests of **E3-2**. Three independent tests were performed.

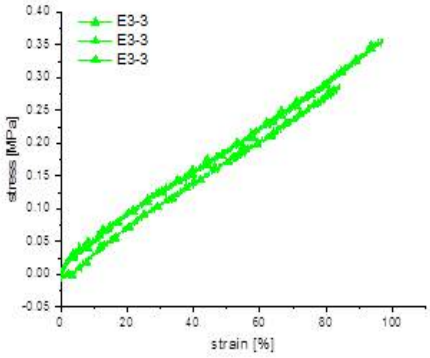

Figure S35 Tensile tests of **E3-3**. Three independent tests were performed.

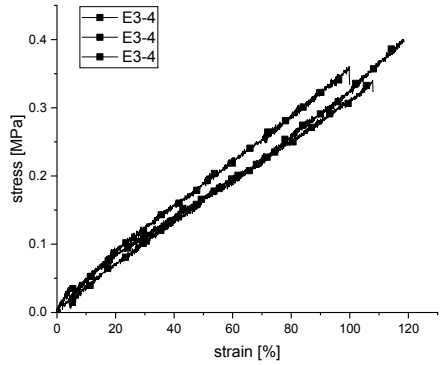

Figure S36 Tensile tests of **E3-4**. Three independent tests were performed.

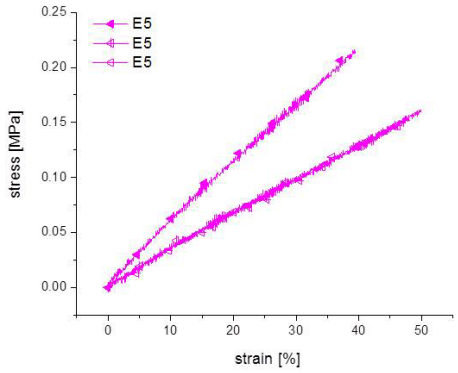

Figure S37 Tensile tests of **E5**. Three independent tests were performed.

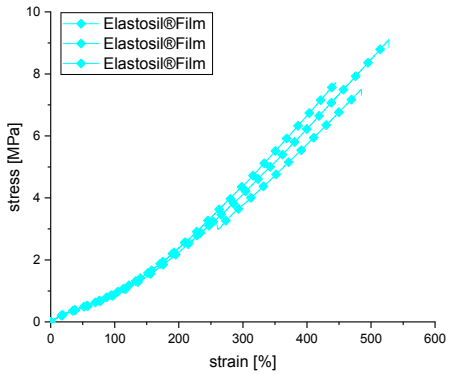

Figure S38 Tensile tests of **Elastosil®Film**. Three independent tests were performed.

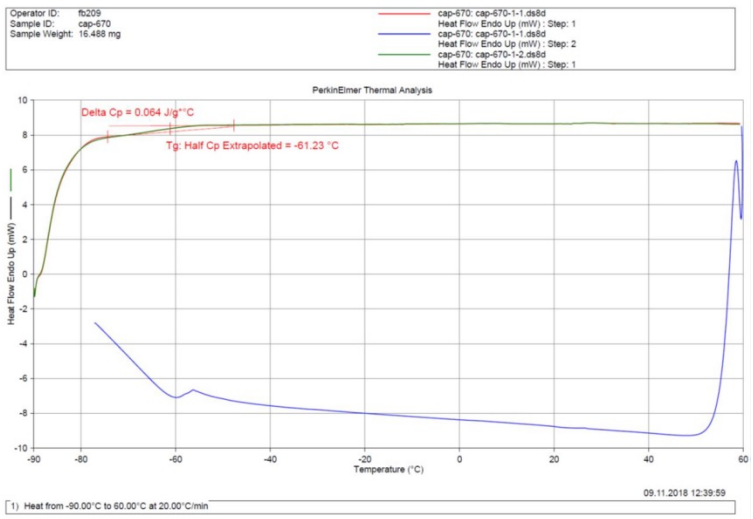

Figure S39 DSC curves of **E3-1**.

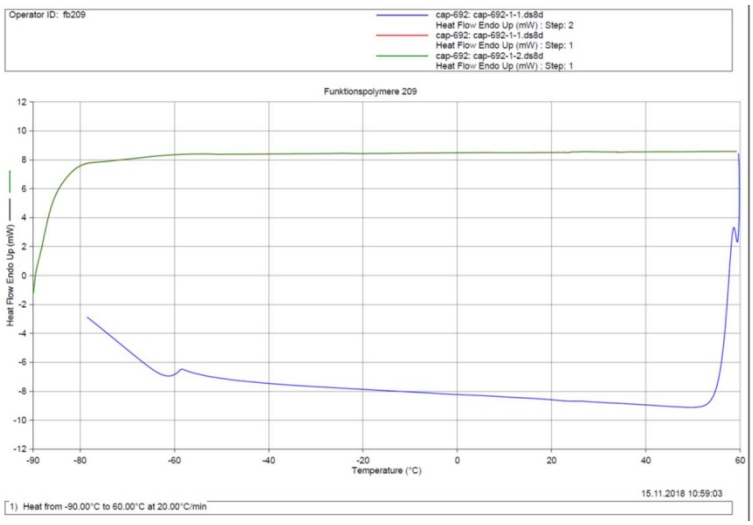

Figure S40 DSC curves of **E3-2**.

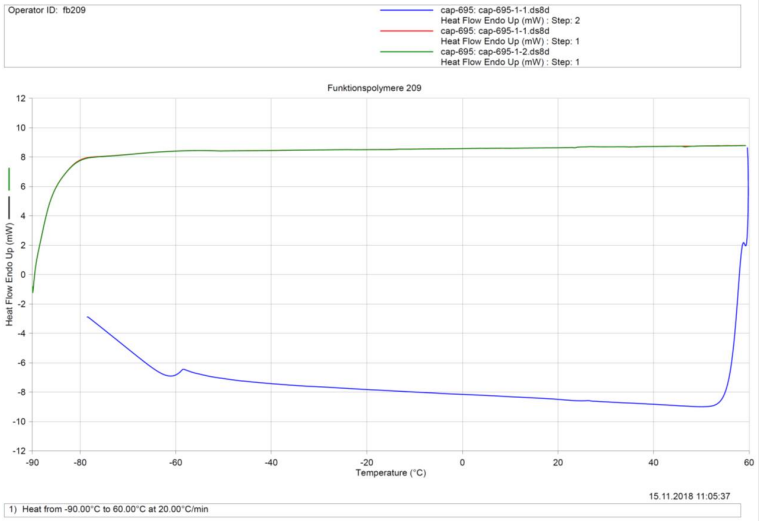

Figure S41 DSC curves of **E3-3**.

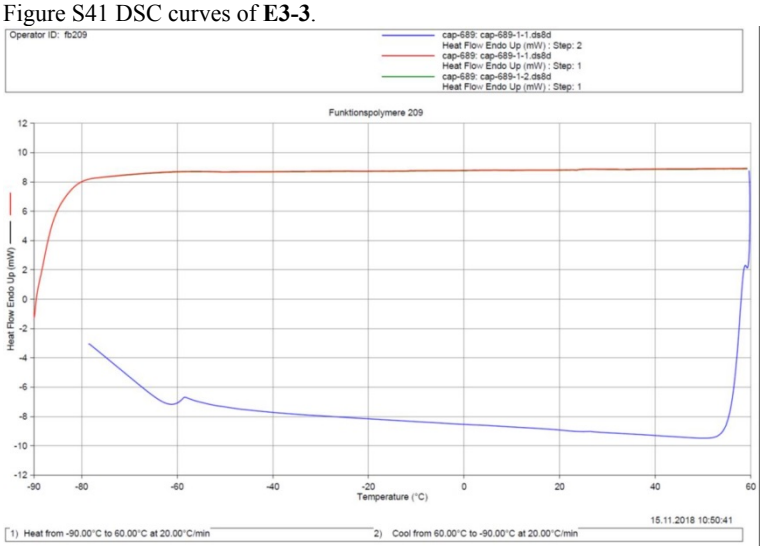

Figure S42 DSC curves of **E3-4**.

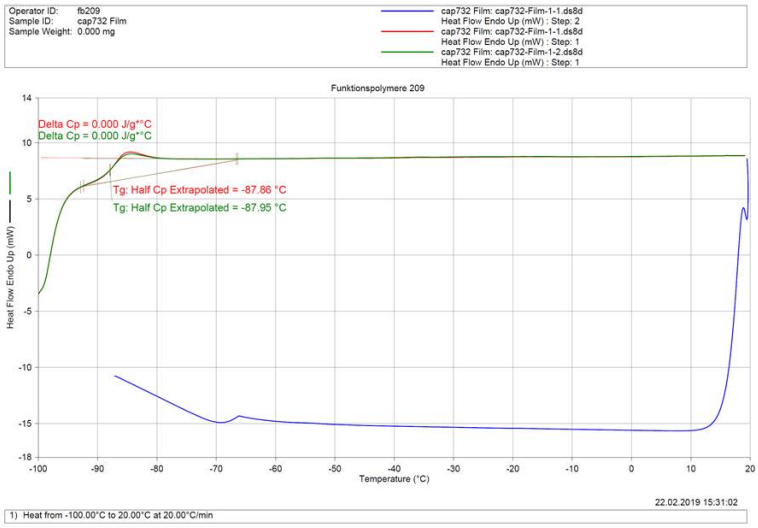

Figure S43 DSC curves of **E5**.

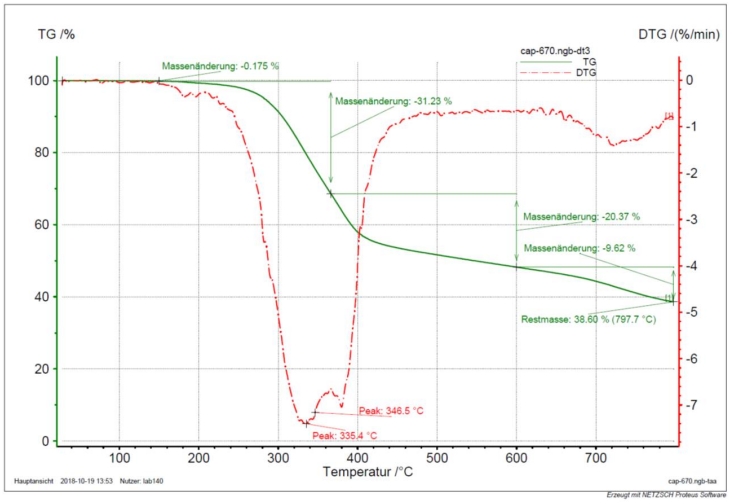

Figure S44 TGA curve of **E3-1** in air.

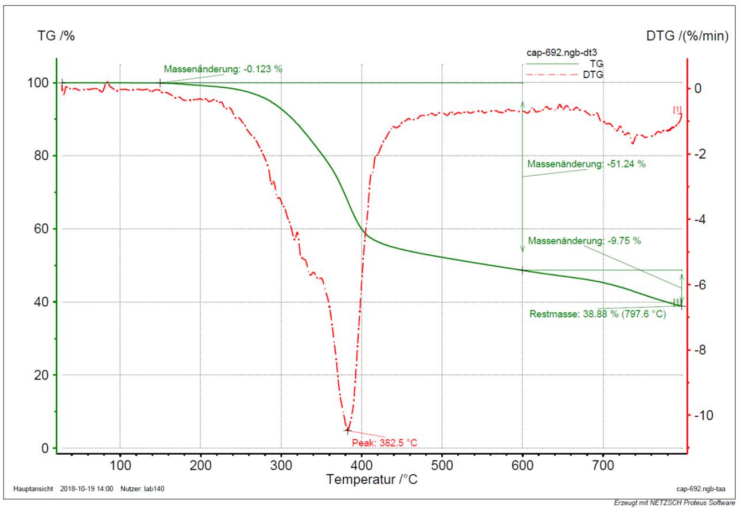

Figure S45 TGA curve of **E3-2** in air.

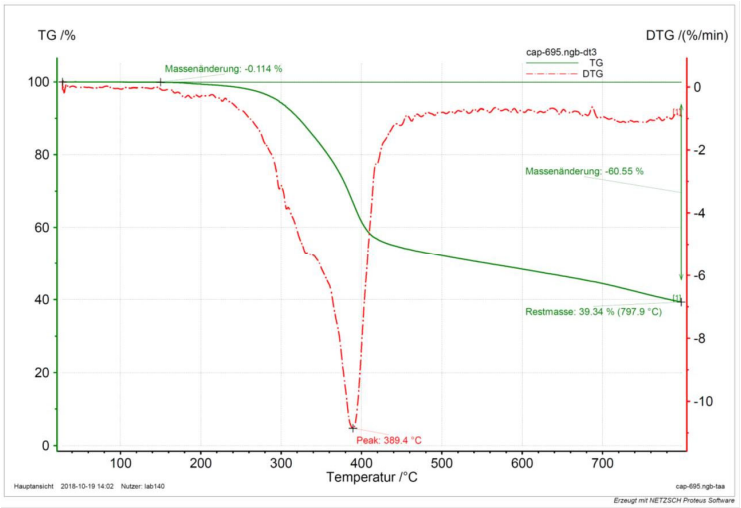

Figure S46 TGA curve of **E3-3** in air.

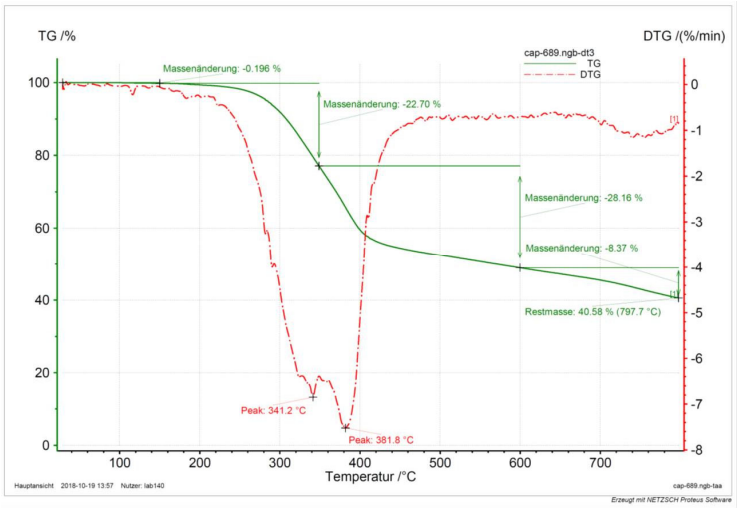

Figure S47 TGA curve of **E3-4** in air.

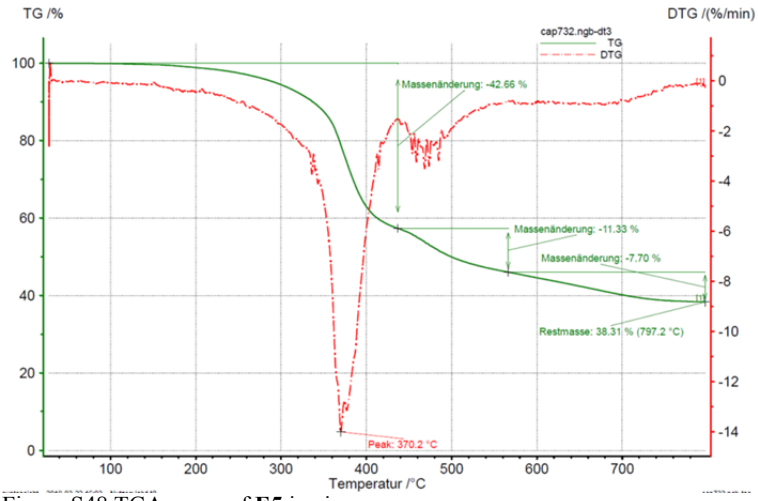

Figure S48 TGA curve of **E5** in air.

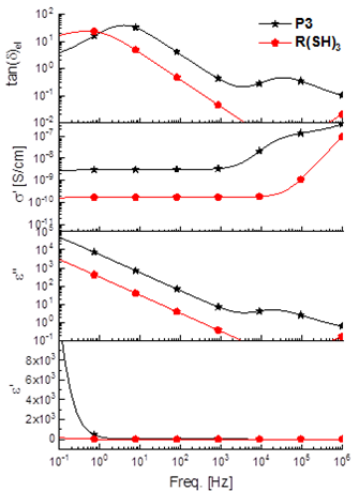

Figure S49 Dielectric properties of **P3** and **R(SH)$_3$**.

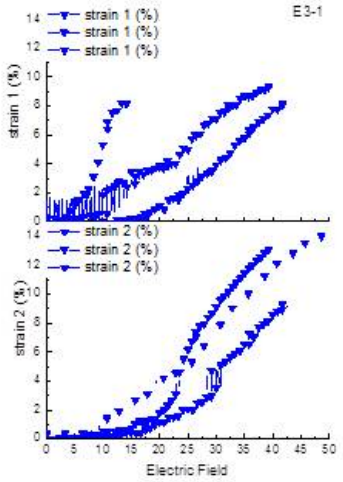

Figure S50 Lateral strain in x-and y-direction (strain 1 and strain 2) of **E3-1** as a function of the applied electric field.

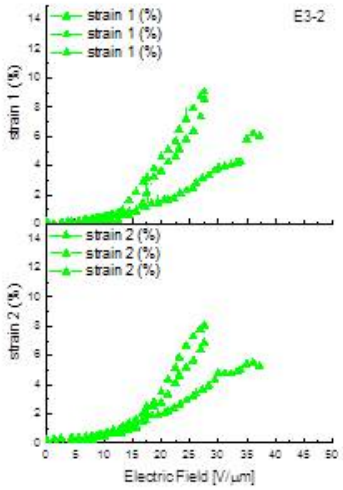

Figure S51 Lateral strain in x-and y-direction (strain 1 and strain 2) of **E3-2** as a function of the applied electric field.

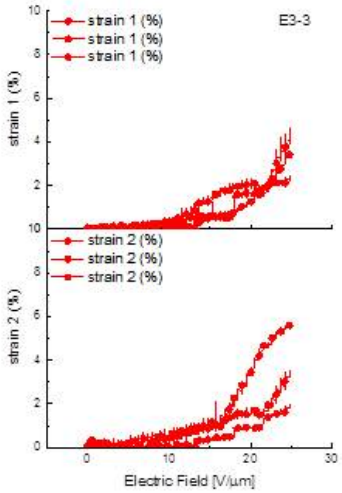

Figure S52 Lateral strain in x-and y-direction (strain 1 and strain 2) of **E3-3** as a function of the applied electric field.

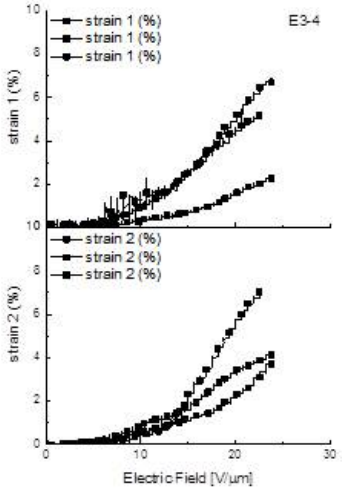

Figure S53 Lateral strain in x-and y-direction (strain 1 and strain 2) of **E3-4** as a function of the applied electric field.

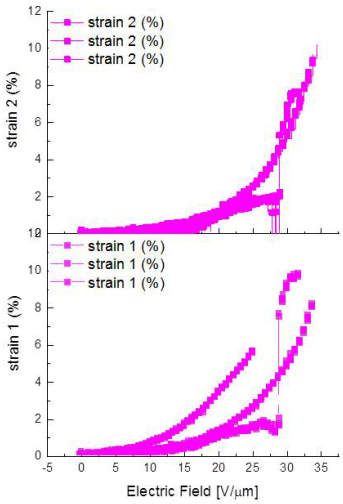

Figure S54 Lateral strain in x-and y-direction (strain 1 and strain 2) of **E3-4** as a function of the applied electric field.

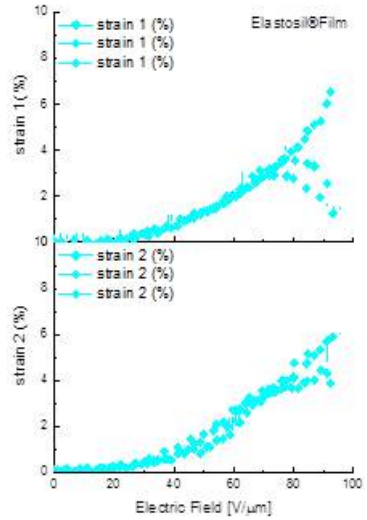

Figure S55 Lateral strain in x-and y-direction (strain 1 and strain 2) of **Elastosil®Film** as a function of the applied electric field.

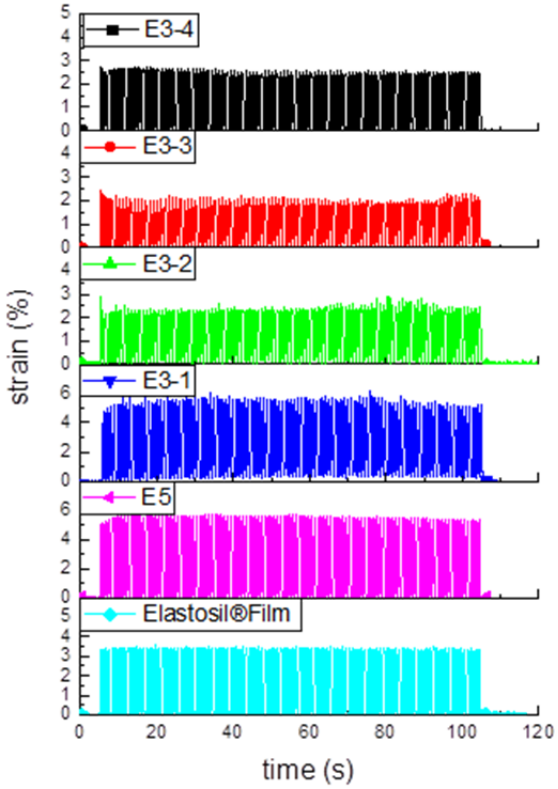

Figure S56 Average lateral strain of **E3-Y** and **Elastosil®Film** as a function of the applied electric field (DC) operated at 1 Hz. The electric field was 80 V/μm for **Elastosil®Film**, 30 V/μm for **E3-1**, 25 V/μm for **E3-2/E3-3**, and 20 Vμm for **E3-4**.

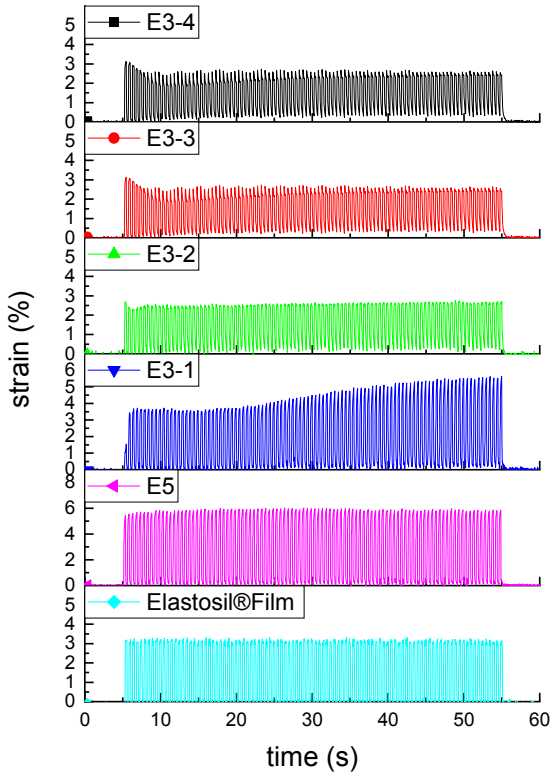

Figure S57 Average lateral strain of **E3-Y** and **Elastosil®Film** as a function of the applied electric field (DC) operated at 2 Hz. The electric field was 80 V/μm for **Elastosil®Film**, 30 V/μm for **E3-1**, 25 V/μm for **E3-2/E3-3**, and 20 Vμm for **E3-4.**

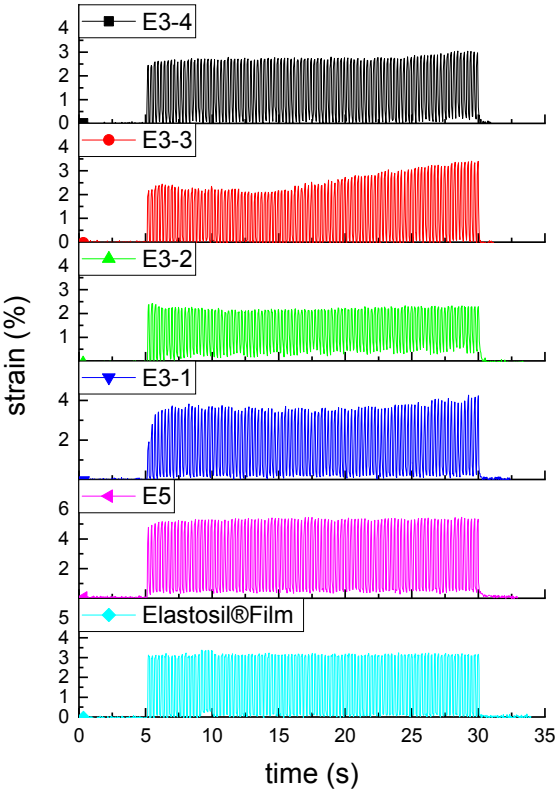

Figure S58 Average lateral strain of **E3-Y** and **Elastosil®Film** as a function of the applied electric field (DC) operated at 4 Hz. The electric field was 80 V/μm for **Elastosil®Film**, 30 V/μm for **E3-1**, 25 V/μm for **E3-2/E3-3**, and 20 Vμm for **E3-4.**

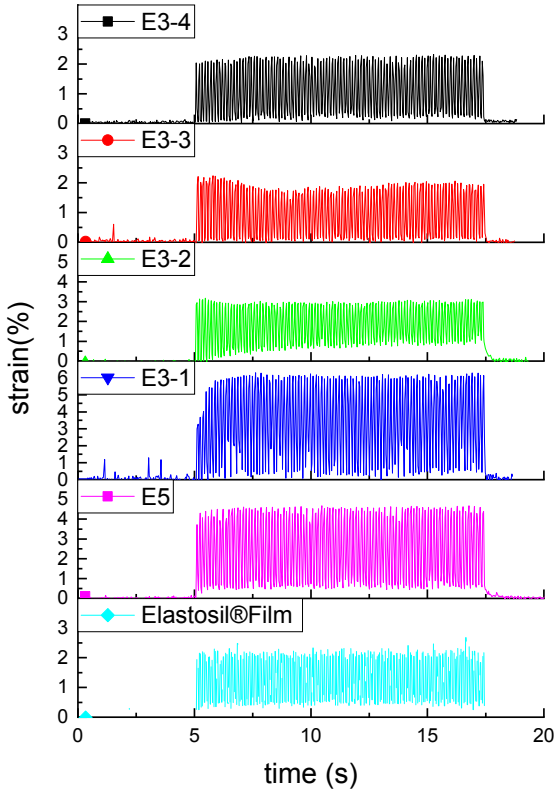

Figure S59 Average lateral strain of **E3-Y** and **Elastosil®Film** as a function of the applied electric field (DC) operated at 8 Hz. The electric field was 80 V/μm for **Elastosil®Film**, 30 V/μm for **E3-1**, 25 V/μm for **E3-2/E3-3**, and 20 Vμm for **E3-4.**

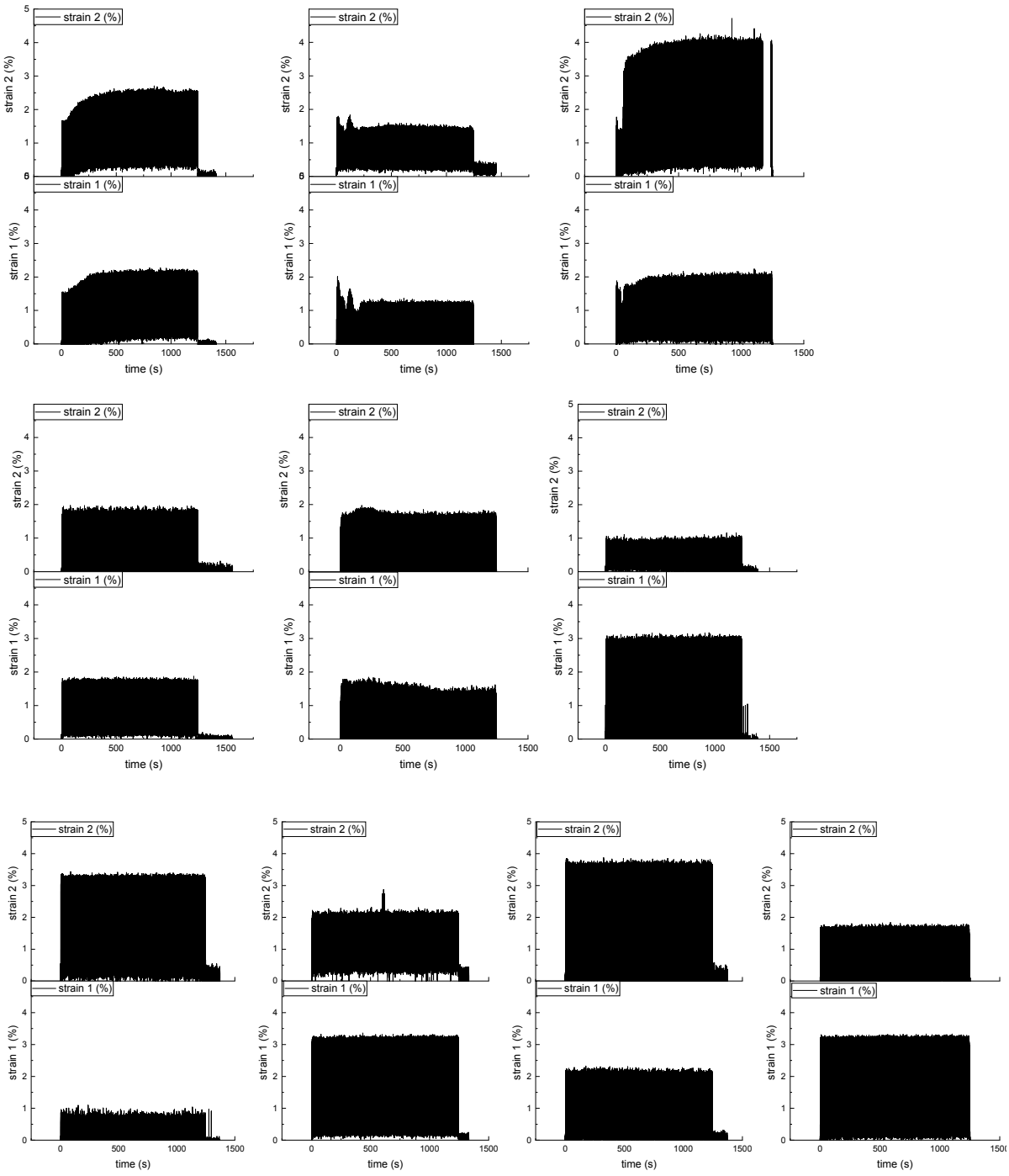

Figure S60 10 x 10.000 operation cycles at 8 Hz at 25 V/µm of a circular DEA test device constructed from a 75 µm-thin film of **E3-1** with an area diameter of 8 mm. Strain 1 is defined as the lateral strain in x-direction. Strain 2 is defined as the lateral strain in y-direction.

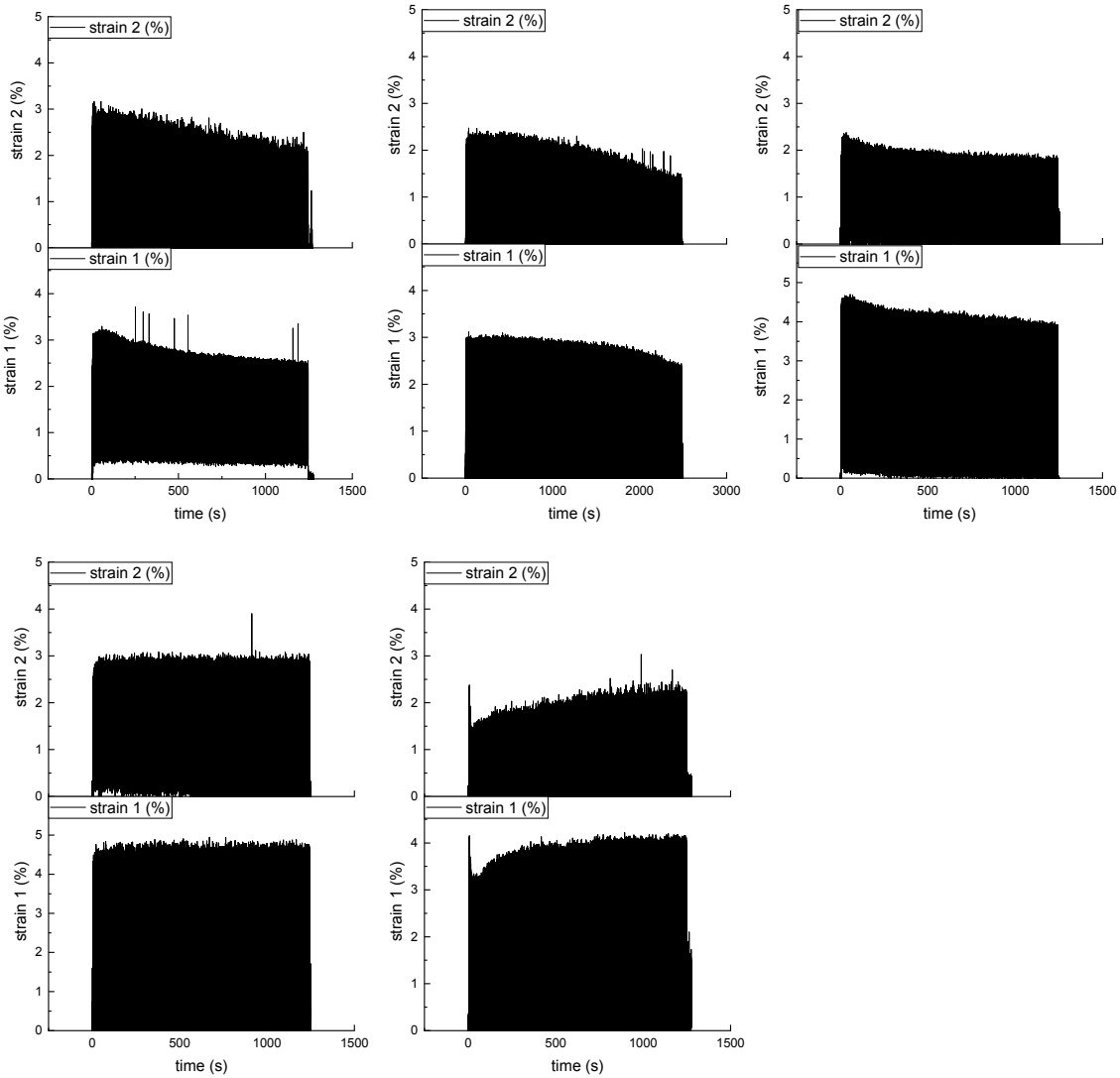

Figure S61 5 x 10.000 operation cycles + 1 x 20.0000 at 8 Hz at 29 V/µm of a circular DEA test device constructed from a 85 µm-thin film of **E3-2** with an area diameter of 8 mm. Strain 1 is defined as the lateral strain in x-direction. Strain 2 is defined as the lateral strain in y-direction.

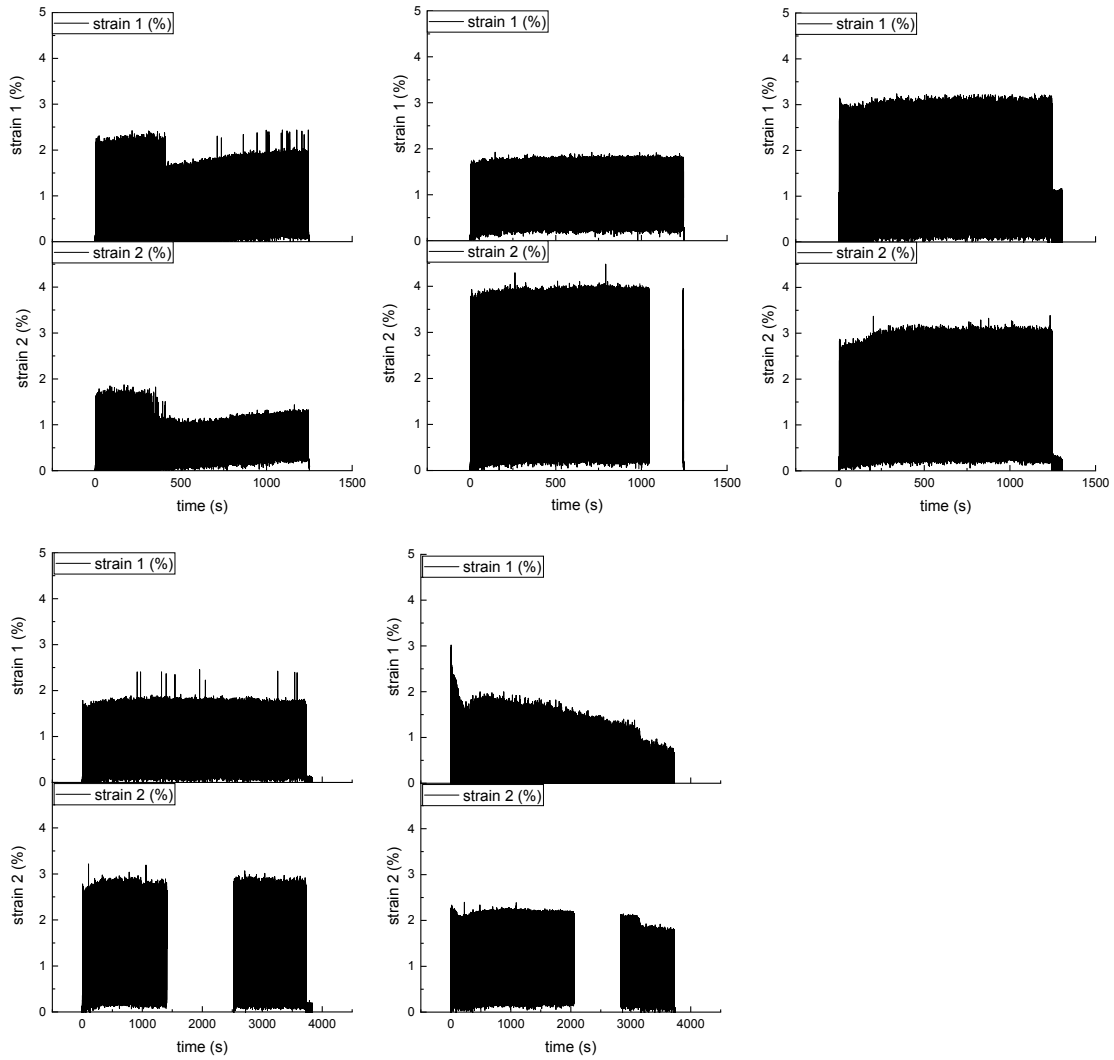

Figure S62 3 x 10.000 + 2 x 30.0000 DEA operation cycles at 8 Hz at 25 V/µm of a circular DEA test device constructed from a 90 µm-thin film of **E3-3** with an area diameter of 8 mm. Strain 1 is defined as the lateral strain in x-direction. Strain 2 is defined as the lateral strain in y-direction.

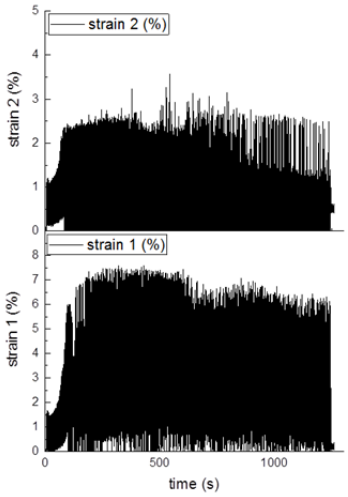

Figure S63 1 x 10.000 DEA operation cycles at 8 Hz at 15 V/µm of a circular DEA test device constructed from a 100 µm-thin film of **E3-4** with an area diameter of 8 mm. Strain 1 is defined as the lateral strain in x-direction. Strain 2 is defined as the lateral strain in y-direction.

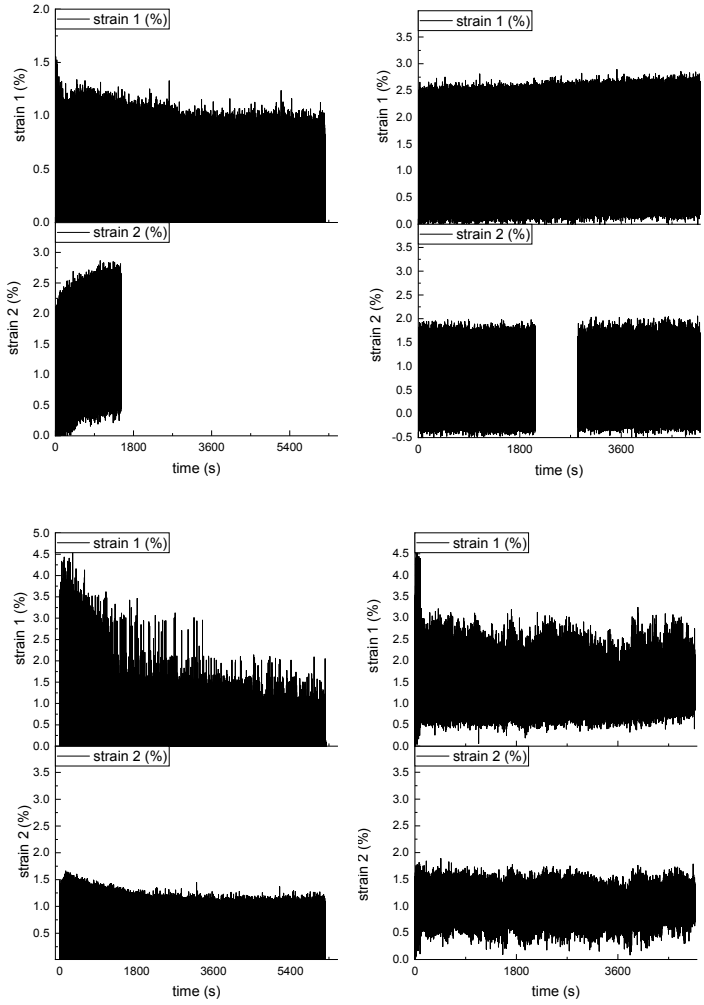

Figure S64 2 x 50.000 and 2 x 40.000 DEA operation cycles at 8 Hz at 25 V/µm of a circular DEA test device constructed from a 85 µm-thin film of **E5** with an area diameter of 8 mm. Strain 1 is defined as the lateral strain in x-direction. Strain 2 is defined as the lateral strain in y-direction.