

Supplementary Information

Reliability of R2R-printed, flexible electrodes for e-clothing applications

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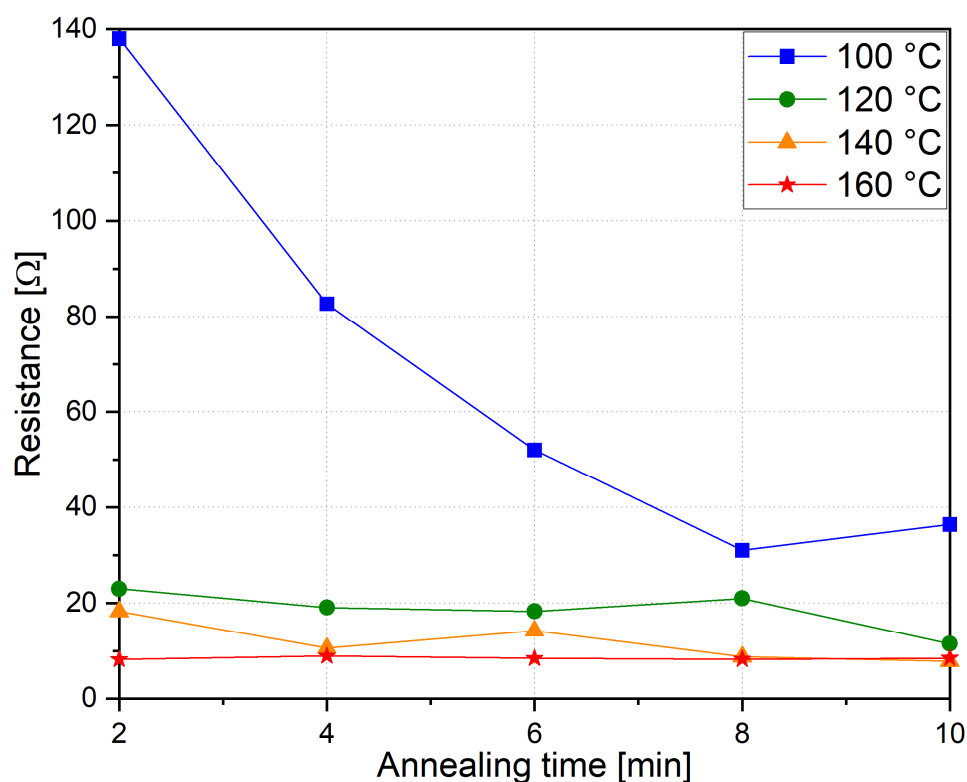


Figure S1. Influence of annealing time and temperature on the resistance of the electrodes for Asahi SW1400 paste. To reduce the impact of high temperature on the elasticity of the TPU and the carrier, the temperature of 120 °C has been selected for the annealing process throughout the course of this research.

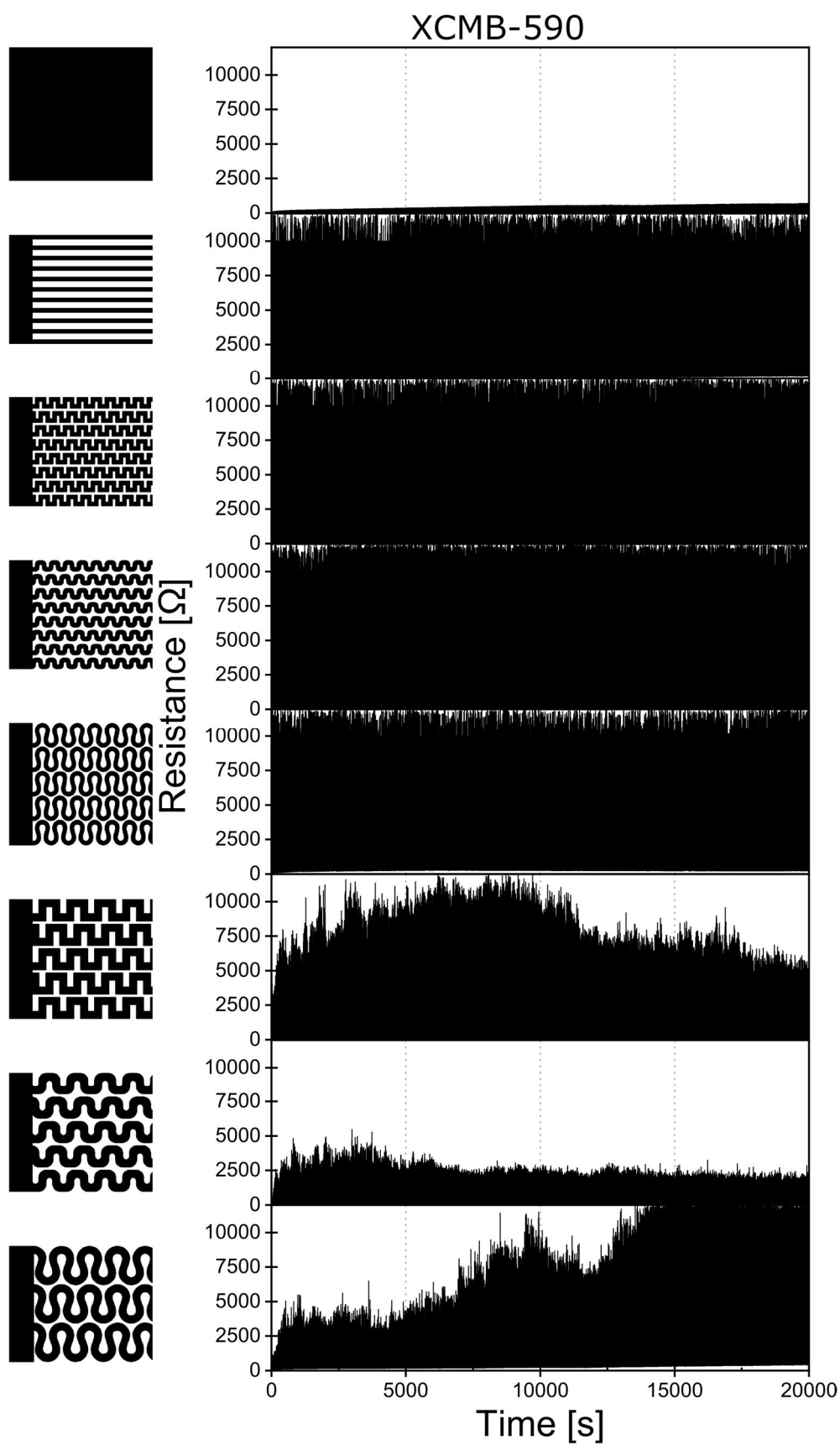


Figure S2. The resistance of various shape electrodes for PPG XCMB-590 paste. The plots depict the change of resistance during the elongation and relaxation cycle. The full cycle consisted of 10,000, 10% elongation cycles, at speed 0.5Hz.

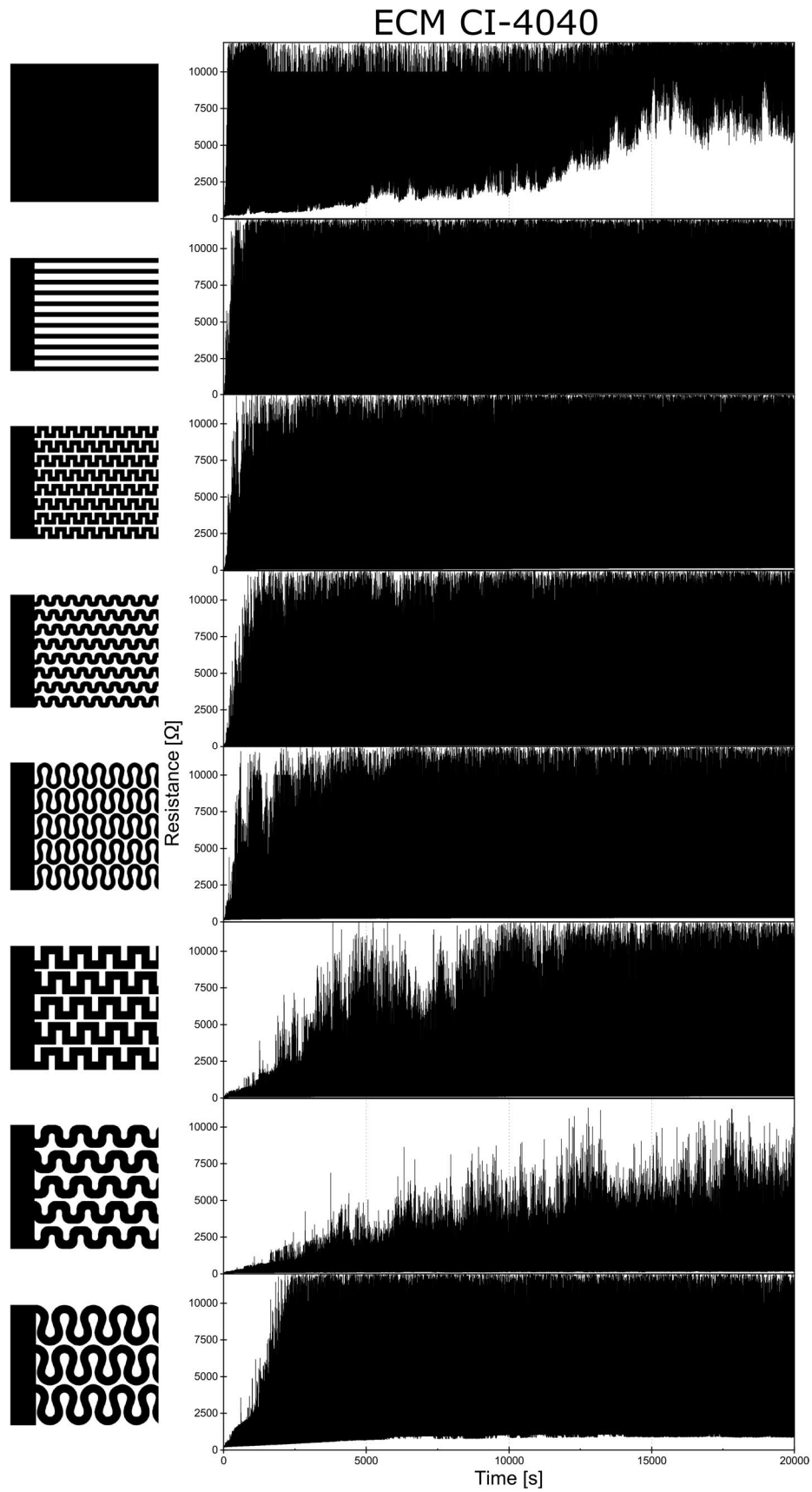


Figure S3. The resistance of various shape electrodes for ECM CI-4040 paste. The plots depict the change of resistance during the elongation and relaxation cycle. The full cycle consisted of 10,000, 10% elongation cycles, at speed 0.5Hz.

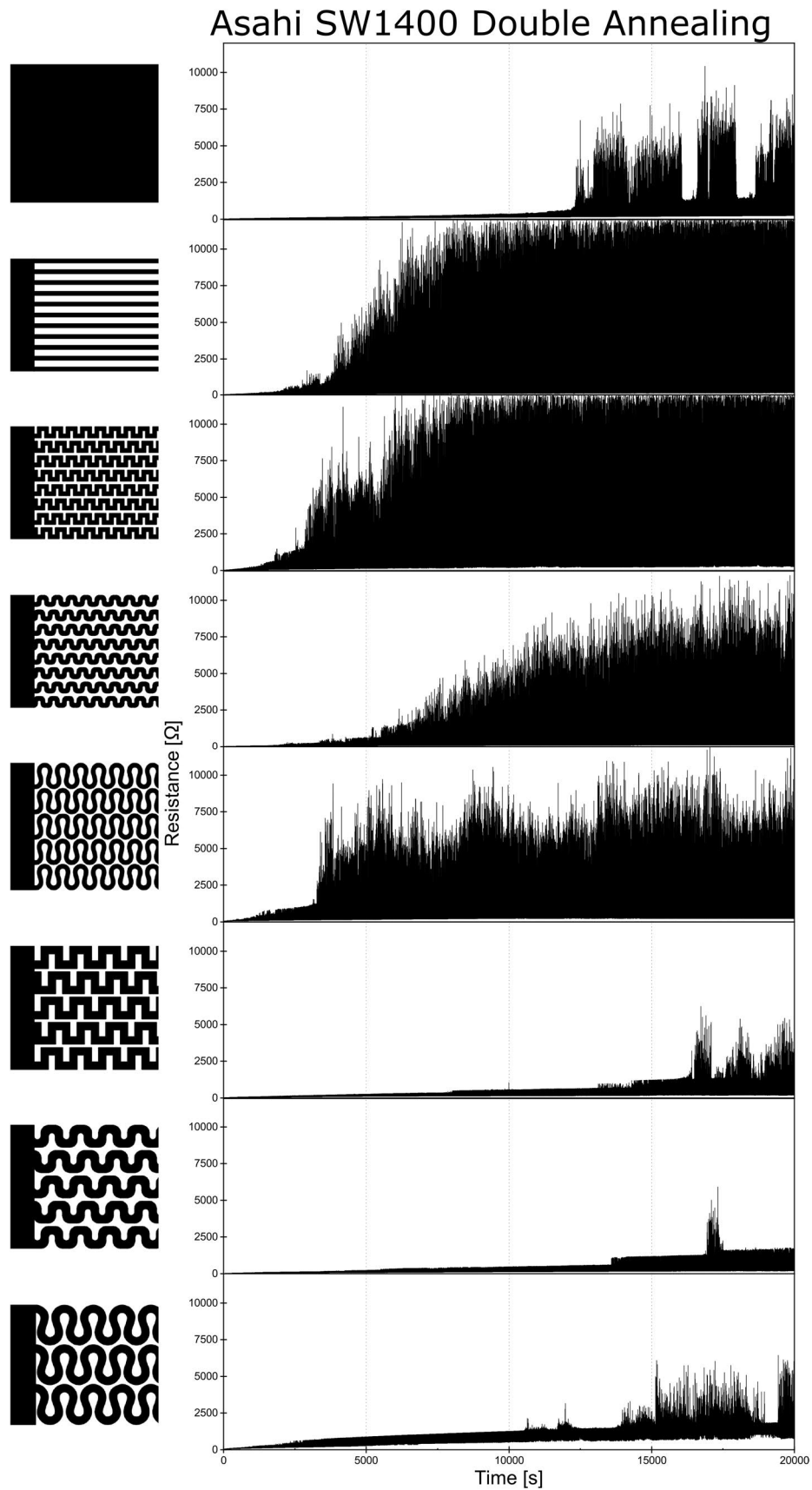


Figure S4. The resistance of various shape electrodes for Asahi SW1400 paste that has been annealed twice during the fabrication process. The plots depict the change of resistance during the elongation and relaxation cycle. The full cycle consisted of 10,000, 10% elongation cycles, at speed 0.5Hz.

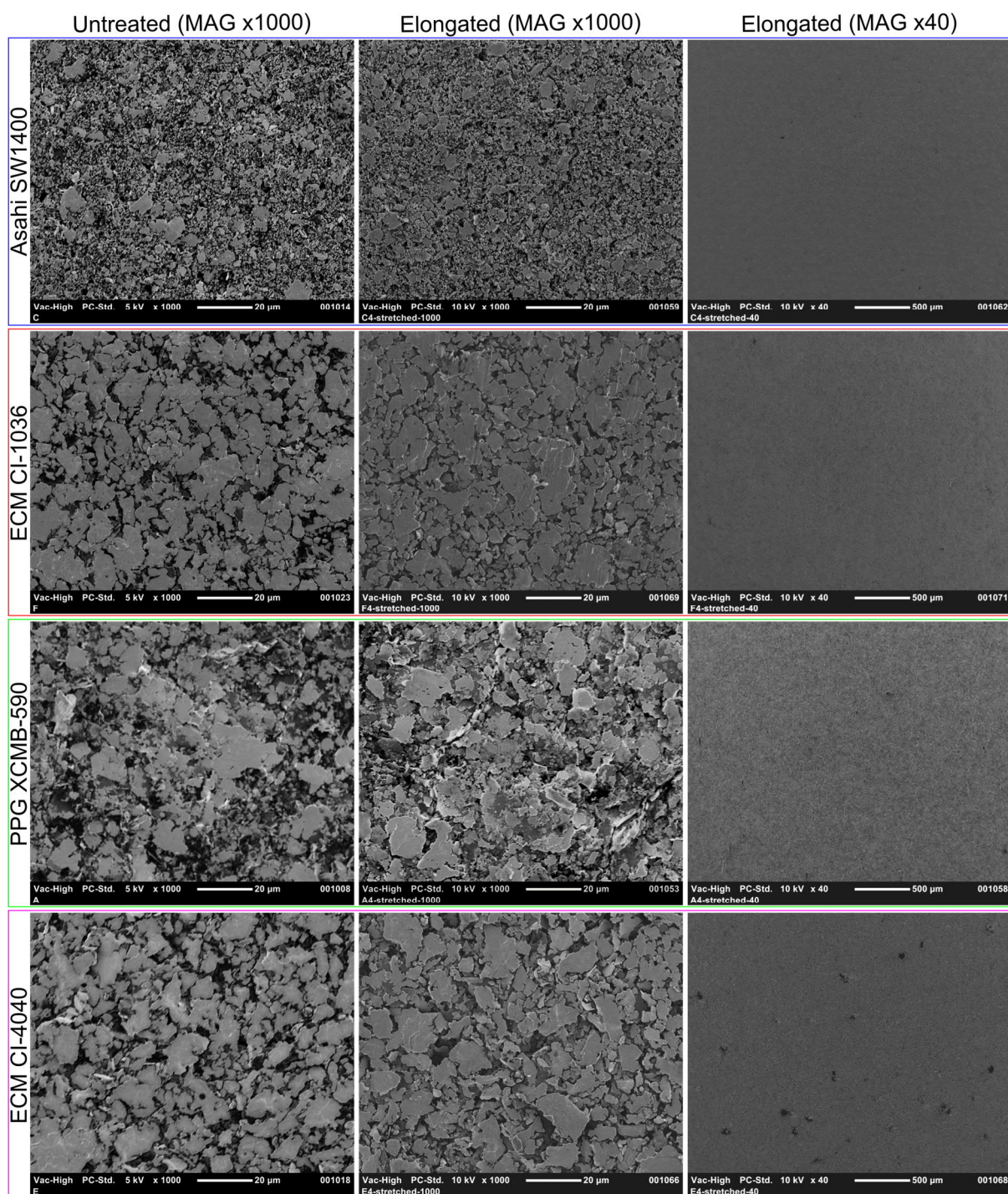


Figure S5. SEM images of all pastes used in this research, before and after elongation cycles. The figures of Asahi SW1400 and ECM CI-1036 do not indicate significant changes on the surface of the electrodes before and after the cycle - the large area figures (MAG x40) demonstrate a smooth surface, deprived of cracks or dents. The presence of dents and cracks is visible for PPG XCMB-590 and ECM CI-4040 pastes. The SEM image of ECM CI-4040 at magnification (x40) demonstrate a significant number of undesired artifacts that appeared after the cycling process.

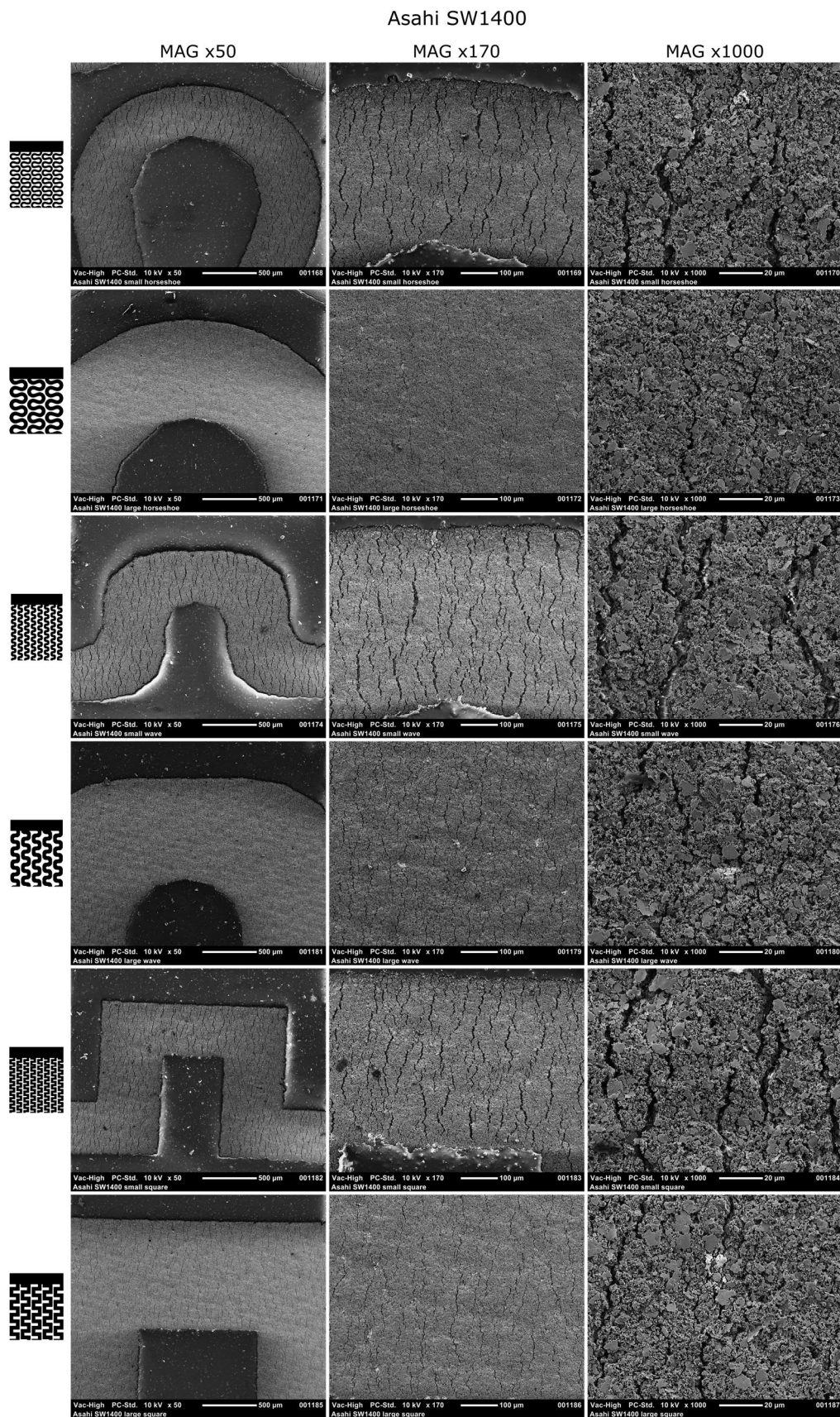


Figure S6. SEM analysis of the influence of elongation on electrodes of various size patterns for Asahi SW1400 paste, at various image magnifications (x5, x170, x1,000). The images illustrate electrodes that are 5 % elongated at the time of taking the image.

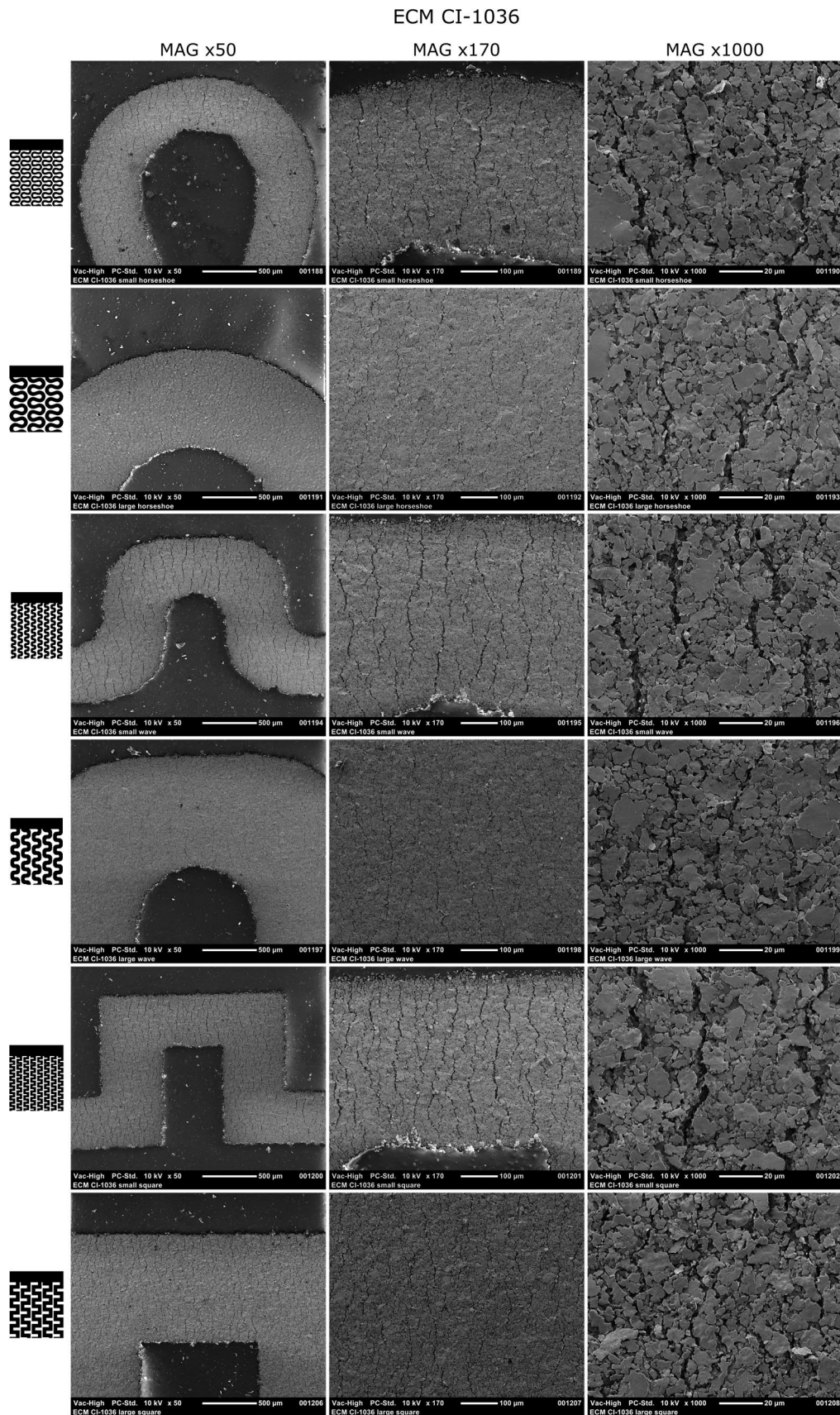


Figure S7. SEM analysis of the influence of elongation on electrodes of various size patterns for ECM CI-1036 paste, at various image magnifications (x5, x170, x1,000). The images illustrate electrodes that are 5 % elongated at the time of taking the image.



Figure S8. Results of suitability of the printed electrodes for commercially available heart-rate monitors. The plot demonstrates satisfactory data acquisition and response to the heart-rate changes over various conditions – valley in the hear-rate date plot at approximately 3 min is a result of cycling downhill.

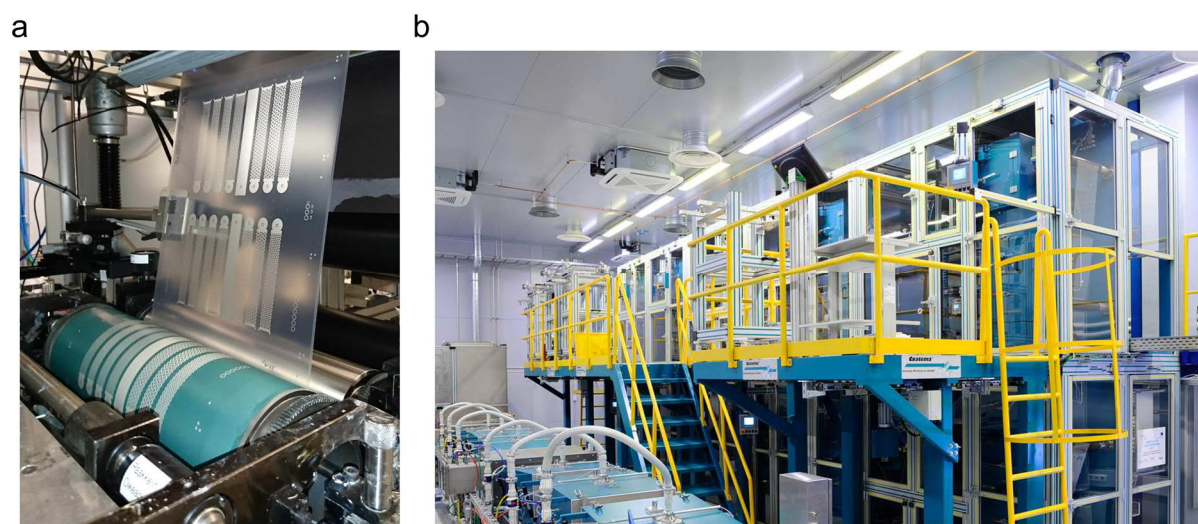


Figure S9. R2R Facilities. a) Rotary screen-printing of stretchable silver electrodes on TPU. b) VTT Oulu MAXI R2R pilot line.



Figure S10. Equipment and materials used in the washing cycling. a) Siemens WD14H540DN washing machine. b) Washing powder Ariel A+ and its ingredients.