SUPPORTING INFORMATION TO:

Flexible and transparent electrodes imprinted from Au nanowires: stability and ageing

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1 Ageing of AuNW electrodes

We monitored the sheet resistance of AuNW electrodes imprinted using ink concentrations between 1 mg/mL and 10 mg/mL on PET foil to study their ageing behaviour. Note that imprinting at 1 mg/mL led to structures that were close to the percolation threshold so that their initial sheet resistance was too high for FTEs.

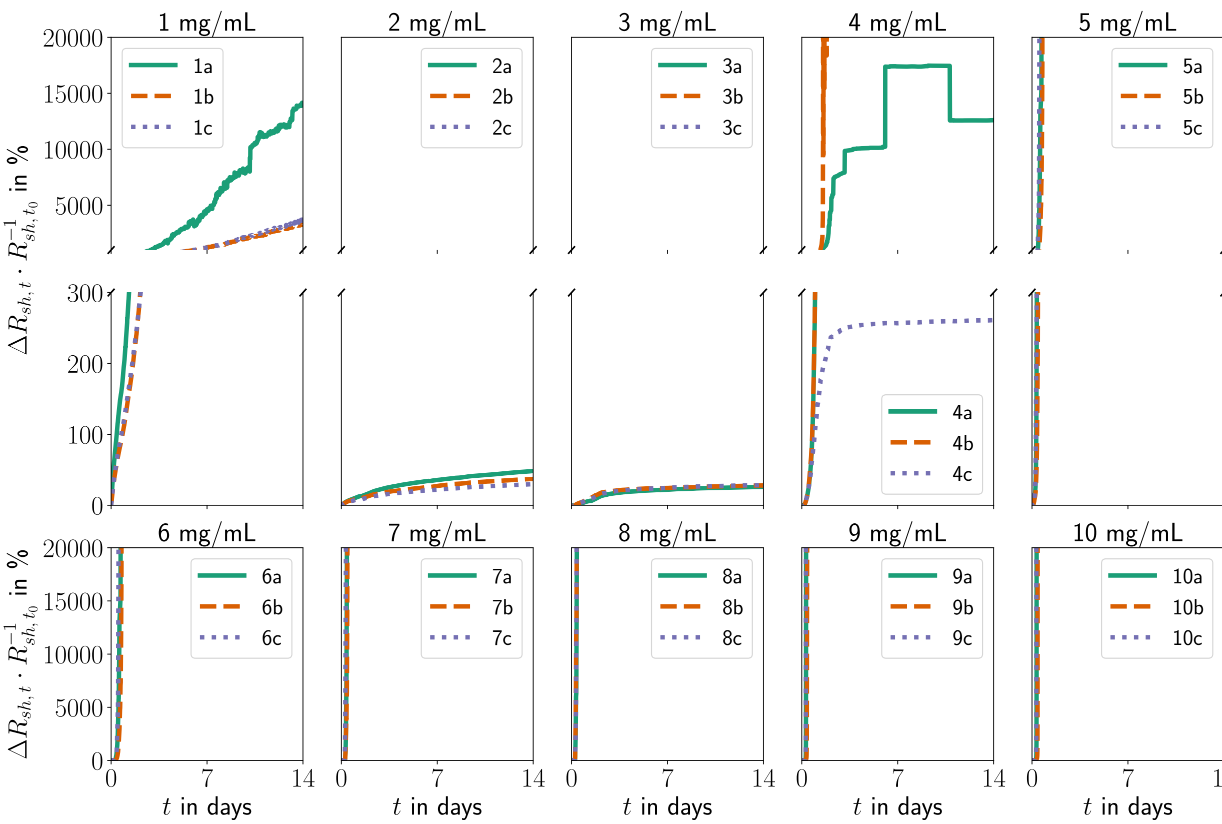

Figure S1: Relative change in sheet resistance $(R_{sh,t} - R_{sh,t_0}) \cdot R^{-1}_{sh,t_0} = \Delta R_{sh,t} \cdot R^{-1}_{sh,t_0}$ after time t for three electrodes each, imprinted at the respective same concentration c_{Au}.

2 AuNW properties

2.1 Wire arrangement and inter-wire distance within printed lines

SAXS measurements were carried out to determine the wires' arrangement within lines imprinted at $c_{Au} = 2\,\mathrm{mg/mL}$ and $6\,\mathrm{mg/mL}$. The peak positions $q_{(1,0)}$ and $q_{(1,1)} \approx \sqrt{3} \cdot q_{(1,0)}$ indicate the same 2D hexagonal wire arrangement with a core center-to-center distance of $a_{c-c} = 4.22 \pm 0.04\,\mathrm{nm}$ for both concentrations, according to Förster et al.:[1]

$$a_{c-c} = \frac{4\pi}{\sqrt{3}} \cdot q_{(1,0)}^{-1} = 4\pi \cdot q_{(1,1)}^{-1} = 4.22 \pm 0.04\,\mathrm{nm} \tag{S1}$$

a_{c-c} in TEM appears smaller because a) the wires do not always run straight, but overlap and intertwine, and b) a TEM lamella has a finite thickness and multiple wires overlap.

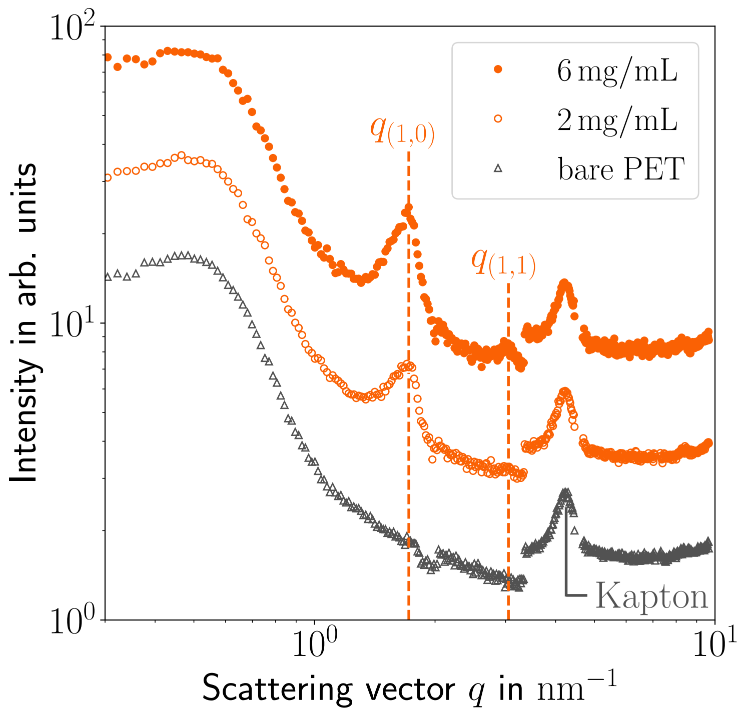

Figure S2: Integrated SAXS scattering of grids imprinted at 2 mg/mL (relatively stable electrode) and 6 mg/mL (highly instable electrode) on PET as well as of bare PET as reference (the Kapton® peak stems from the Kapton® window used to separate the sample from the evacuated scattering path | scattering curves have been shifted for better visibility).

2.2 Organic content: volumetric fraction

The volumetric fraction of OAm in printed lines was estimated from the organic content of AuNW that had been purified twice and analyzed via thermogravimetric analysis (TGA) in a previous publication:

$$f_{V,OAm} = \frac{f_{w,OAm} \cdot (\rho_{OAm})^{-1}}{f_{w,OAm} \cdot (\rho_{OAm})^{-1} + f_{w,Au} \cdot (\rho_{Au})^{-1}} \cdot 100\,\% \approx 87.05\,\mathrm{vol\%} \tag{S2}$$

with $f_{V,OAm}$ the volume fraction of OAm, $f_{w,OAm} \approx 22\,\mathrm{wt\%}$ the mass fraction of OAm (determined via TGA by Bettscheider et al.[2]), $f_{w,Au} \approx 78\,\mathrm{wt\%}$ the mass fraction of Au, $\rho_{OAm} = 0.81\,\mathrm{g/cm^3}$ the density of OAm[3] and $\rho_{Au} = 19.3\,\mathrm{g/cm^3}$ the density of Au,[4] both at room temperature.

3 Sintered line morphology in cross section at 2 mg/mL

Transmission electron microscopy (TEM) was used to test the effect of plasma sintering on the inner morphology of the printed lines. For grids imprinted at 2 mg/mL, plasma sintering visibly coarsened the inner morphology down to the substrate.

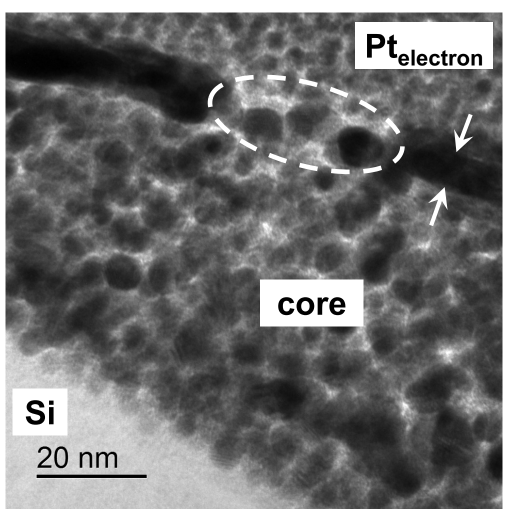

Figure S3: TEM close-up of the inner line morphology directly after plasma sintering for grids imprinted at 2 mg/mL on a Si wafer. White arrows indicate the sintered shell. The white dashed oval marks a porous part of the shell.

References

(1) Förster, S.; Timmann, A.; Konrad, M.; Schellbach, C.; Meyer, A.; Funari, S. S.; Mulvaney, P.; Knott, R. Scattering curves of ordered mesoscopic materials. *The journal of physical chemistry. B* **2005**, *109*, 1347–1360.

(2) Bettscheider, S.; Kuttich, B.; Engel, L. F.; González-García, L.; Kraus, T. Bundling of Nanowires Induced by Unbound Ligand. *The Journal of Physical Chemistry C* **2021**, *125*, 3590–3598.

(3) Oleylamine, approximate C18-content 80-90%: SDS. 2009; https://www.fishersci.de/store/msds?partNumber=10400380&productDescription=100ML+Oleylamine%2C+approximate+C18-content+80-90%25&countryCode=DE&language=de.

(4) Haynes, W. M., Ed. *CRC Handbook of chemistry and physics: A ready-reference book of chemical and physical data*, 97th ed.; CRC Press: Boca Raton and London and New York, 2017.