

# Electro-assisted Printing of Soft Hydrogels via Controlled Electrochemical Reactions

## Author Information

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### Affiliations

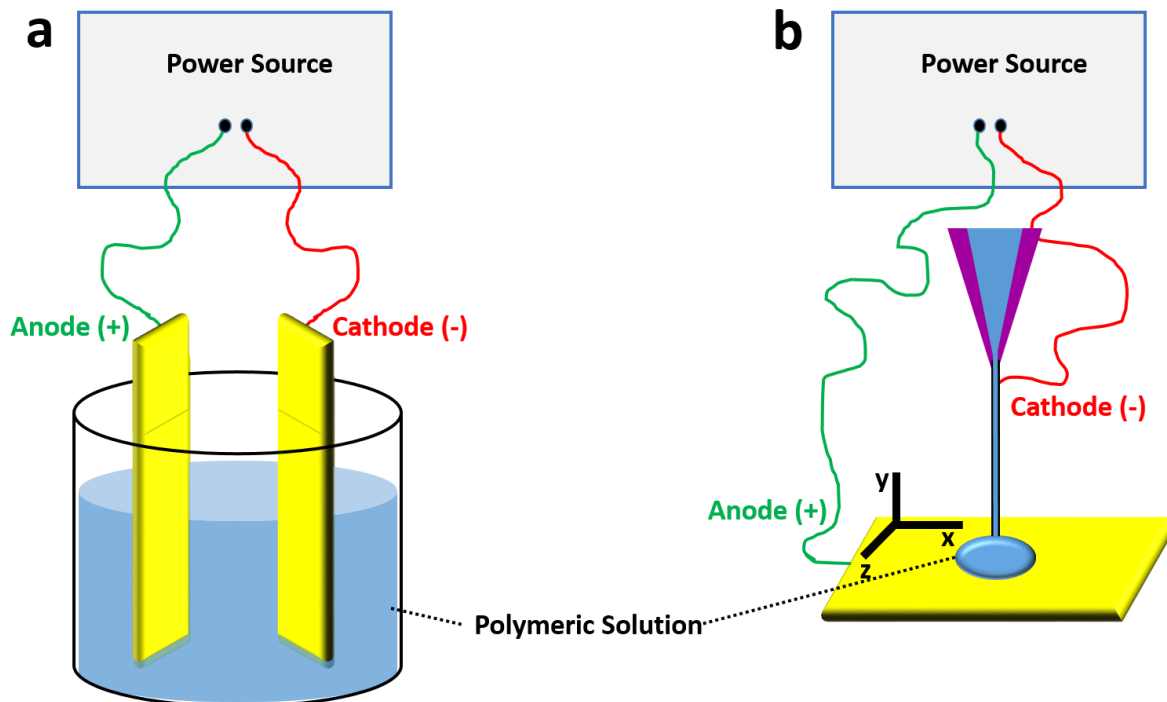
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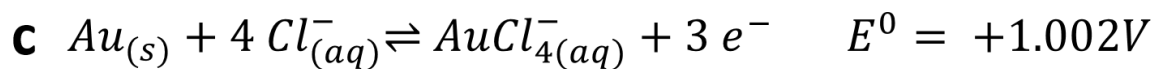
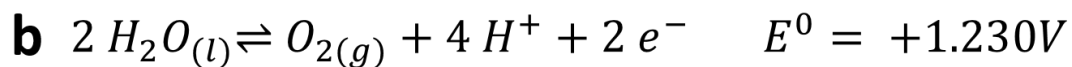
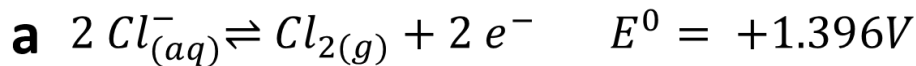
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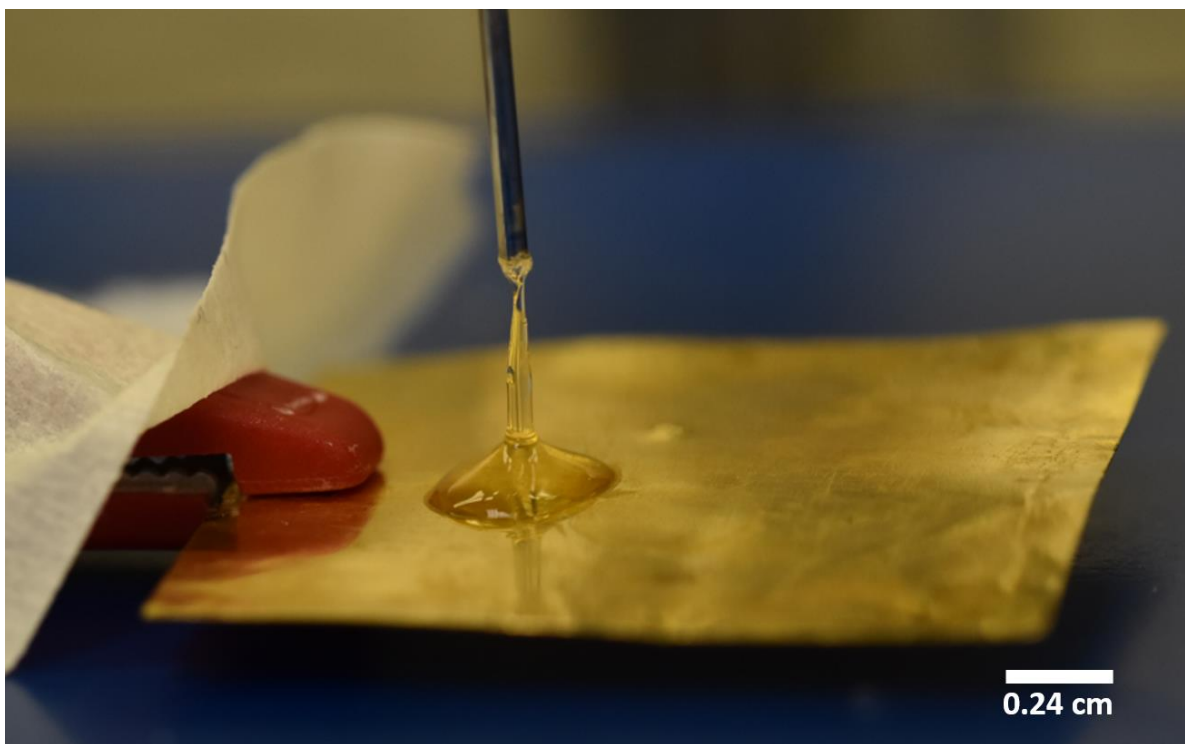
## Supplementary Information



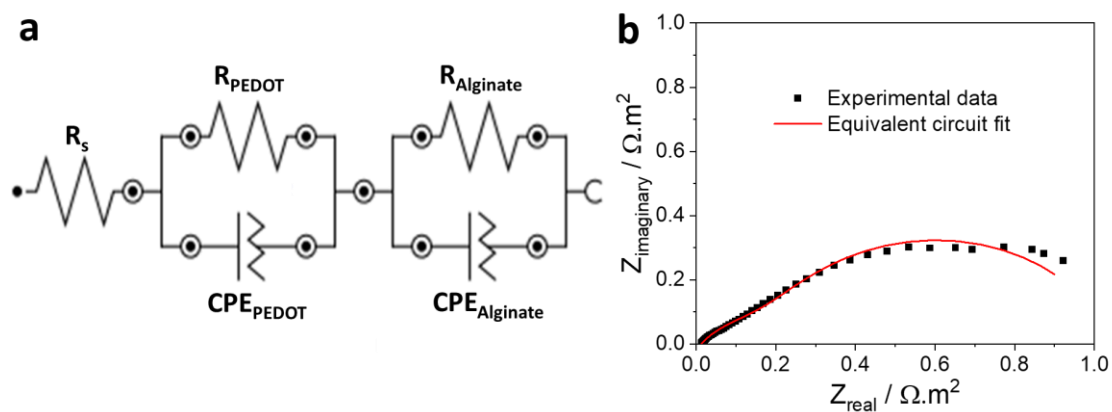
**Supplementary Figure 1 | 2-electrodes configuration system.** **a** The 2-electrodes configuration with cathode (red) and anode (green) is feasible to be applied using a power source using two gold plates or **b** a gold plate and needle system.



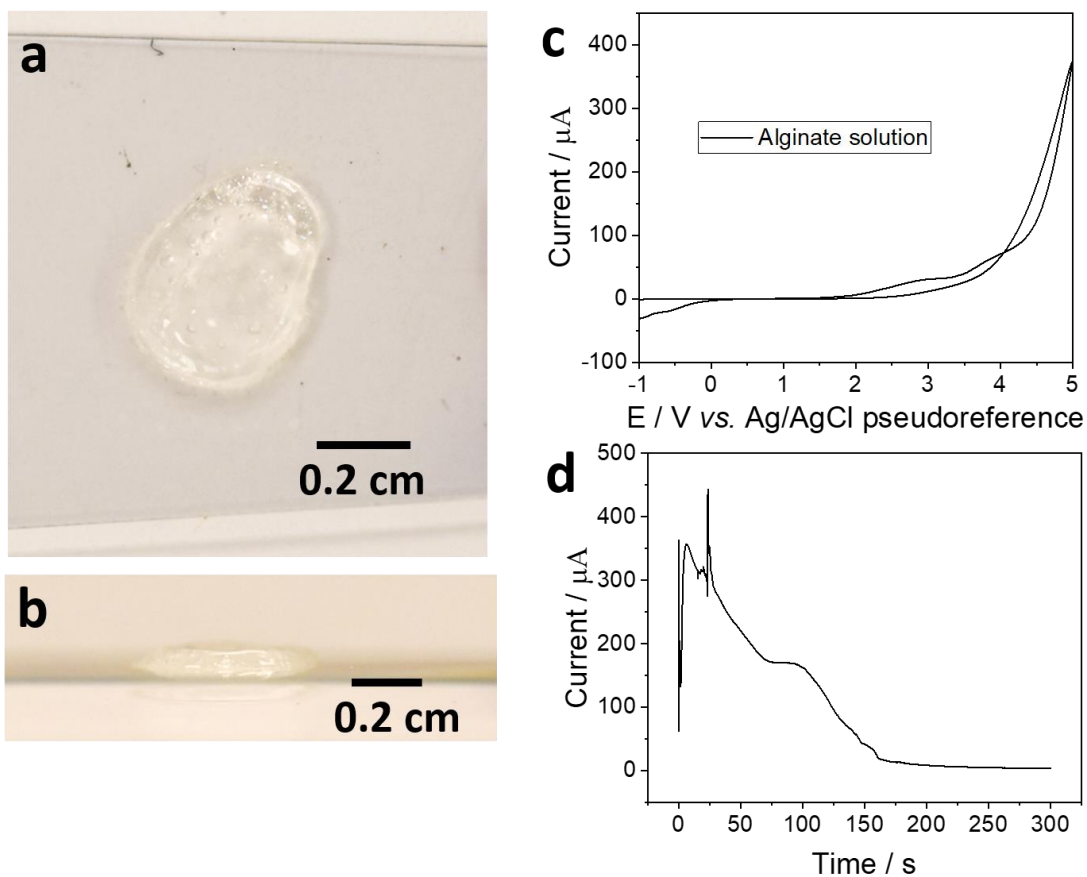
**Supplementary Figure 2 | Standard potential of electrochemical reactions.** **a** Chloride ions oxidation reaction to chlorine gas. **b** Water hydrolysis oxidation reaction to oxygen and protons. **c** Gold oxidation in presence of chloride ions to tetrachloroaurate. The standard electric potentials in aqueous solution was extracted from books<sup>1,2</sup>. It is widely known the water electrolysis in presence of chloride can generate hypochlorite species for electrochemical oxidative treatment of organic waste, but it require high electric potentials<sup>3,4</sup>. Considering gold surface, it was reported only tetrachloroaurate and gold oxide (in form of AuO or AuOH) formation on gold electrodes in aqueous media containing chloride ions (and absence, using perchlorate)<sup>5,6</sup>. Additionally, gold is oxidizing to gold(III) (stabilized by complexation with chloride ions) at the electric potential where the deposition of chitosan hydrogel occurs and tetrachloroaurate ion is well known as oxidizing agent<sup>7-9</sup>.



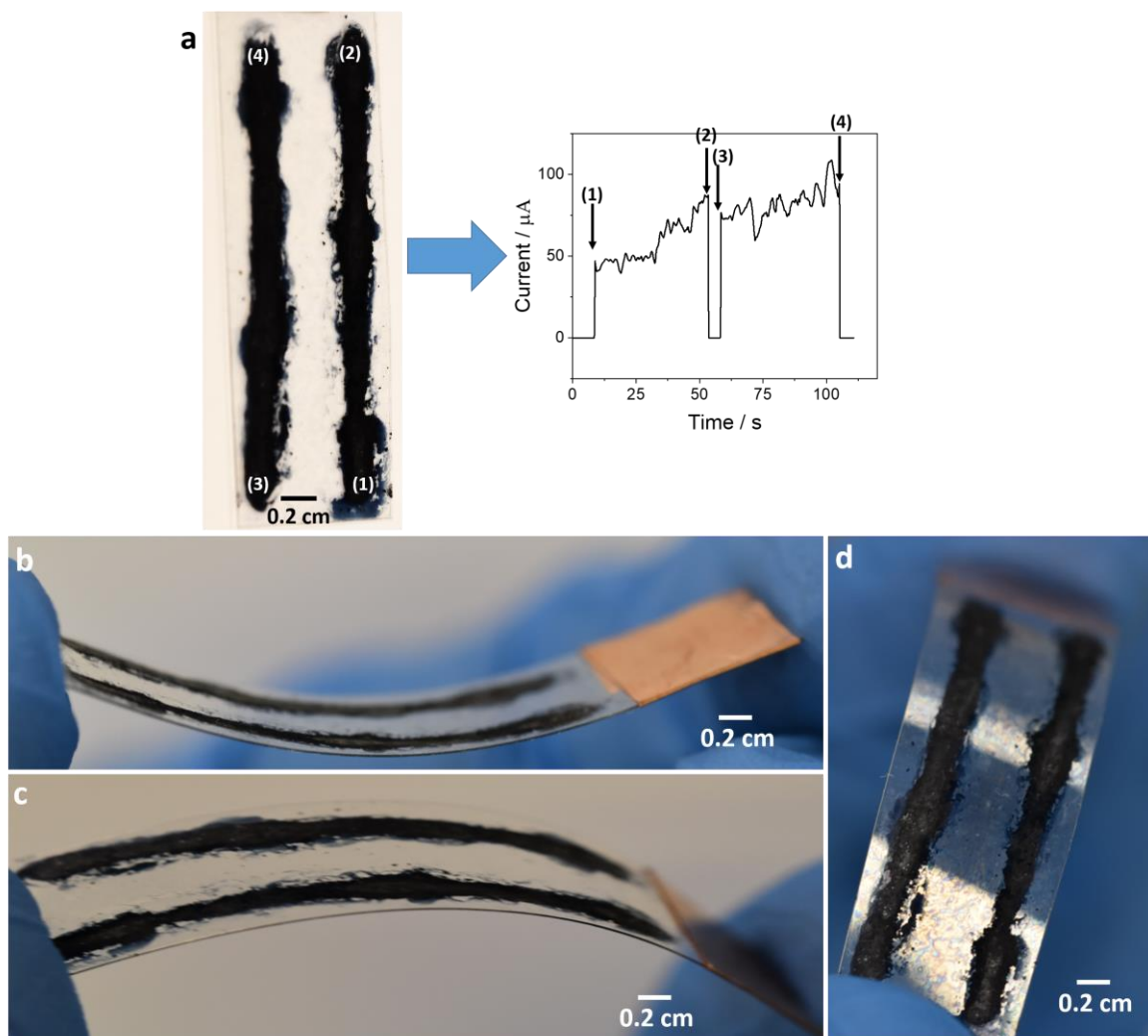
**Supplementary Figure 3 | Precipitated chitosan.** Picture of the precipitated hydrogel of chitosan in the CE (needle) when higher than +2V is applied to the WE.



**Supplementary Figure 4 | Fit and simulation for hybrid PEDOT/alginate.** **a** Equivalent electrochemical circuit for the hybrid PEDOT/alginate. **b** Nyquist plot of the experimental data (black squares) and equivalent circuit fit (red line). The hybrid PEDOT/alginate shows a small semi-circle at low frequencies (PEDOT contribution) and a bigger at high frequencies (alginate contribution).  $\chi^2$  for the simulated data was 0.07307.



**Supplementary Figure 5 | Alginate hydrogel over ITO/PET substrate.** **a** Picture of the alginate hydrogel formed in droplet over ITO/PET substrate top view and **b** side view. **c** Cyclic voltammetry of the alginate solution over ITO/PET substrate. **d** Chronoamperometry at +5V for 300 seconds.



**Supplementary Figure 6 | PEDOT/alginate hydrogel patterning.** **a** Picture of the two parallel lines of PEDOT/alginate hydrogel (left) and the chronoamperogram of the electrodeposition process (right). The numbers describe the movement of the modified 3D-printer nozzle through the ITO/PET surface in direct writing. **b-d** The PEDOT/alginate hydrogel under concave, convex and top view of the convex bending.

## References

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