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PROTOCOL

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Preparation of paper-based devices for reagentless electrochemical (bio)sensor strips

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Why paper-based analytical tools?

- The well-known properties of paper, such as abundance, affordability, lightness, and biodegradability, combined with features of printed electrochemical sensors, have enabled the development of sustainable devices.
- Their blindness toward colored/turbid matrices (i.e., blood, soil), their portability, and the capacity of paper to autonomously filter/react with target species make such devices powerful in establishing point-of-need tools for use by non-specialists.

In this paper:

- his protocol describes the preparation of a voltammetric phosphate sensor and an amperometric nerve agent biosensor.
- These printed strips comprise three electrodes (graphite for working and counter electrodes and silver/silver chloride (Ag/AgCl) for the reference electrode) and nanomodifiers (carbon black and Prussian blue) to improve their performance and specificity.

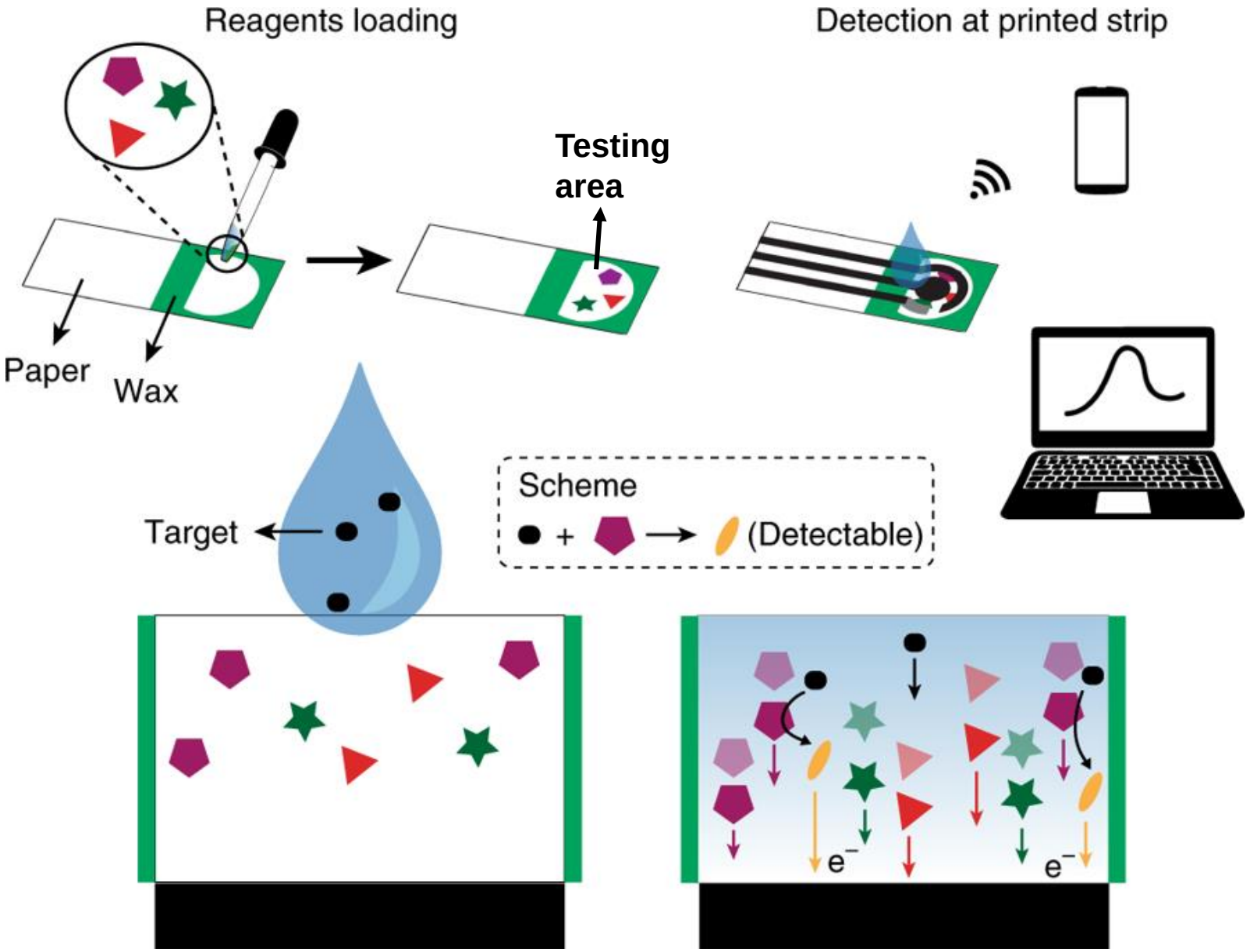
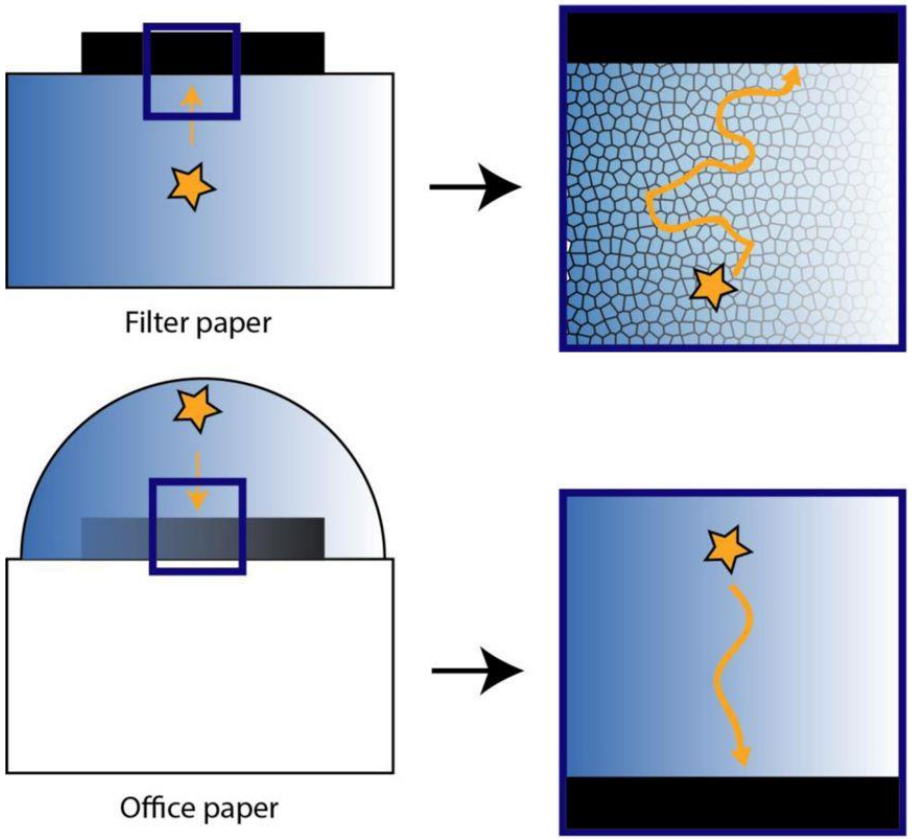


Fig. 1: Configuration of a paper-based electrochemical device.

Experimental design

- Choice of paper



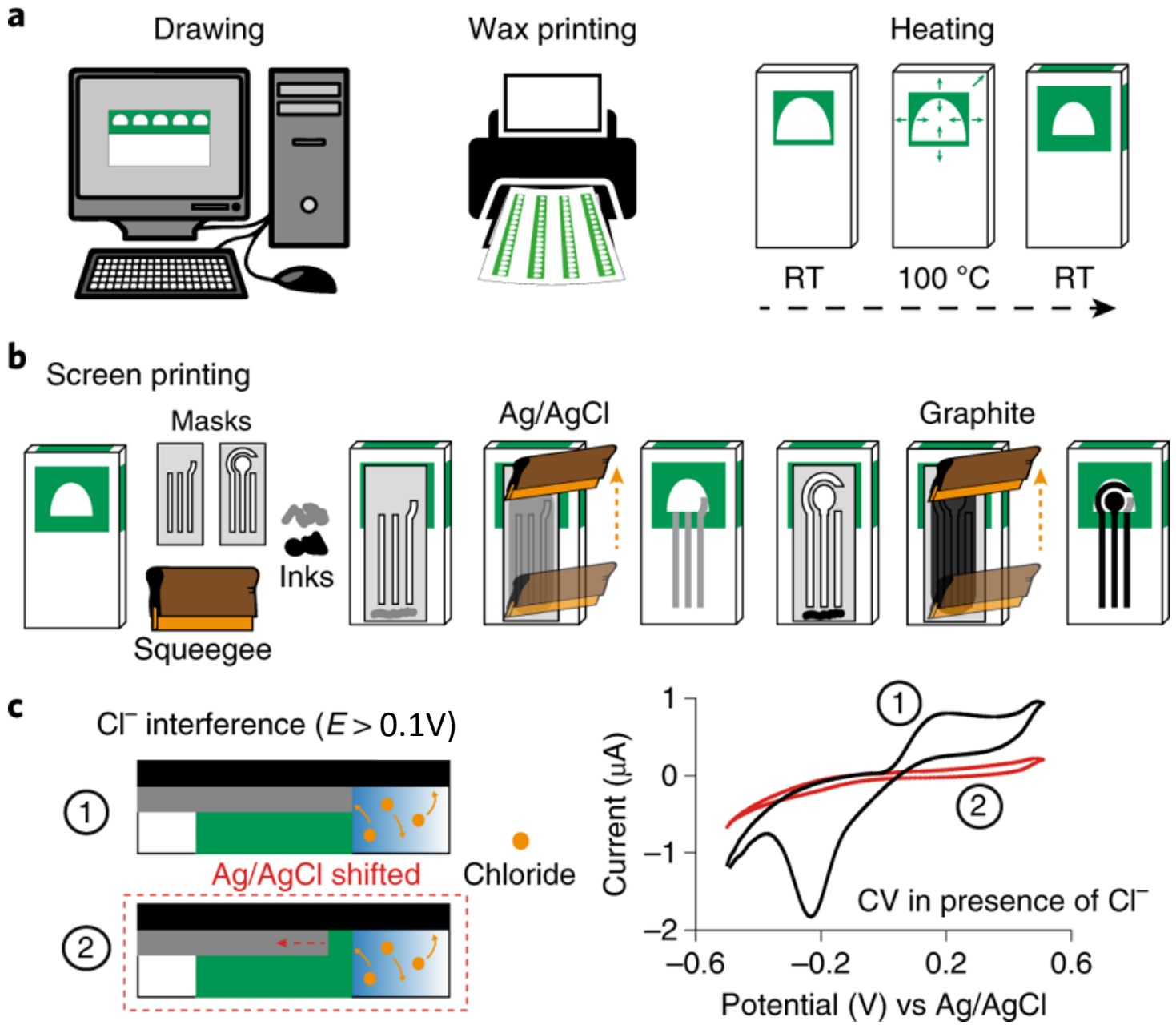


Fig. 2: Manufacture of a paper-based electrochemical sensor.

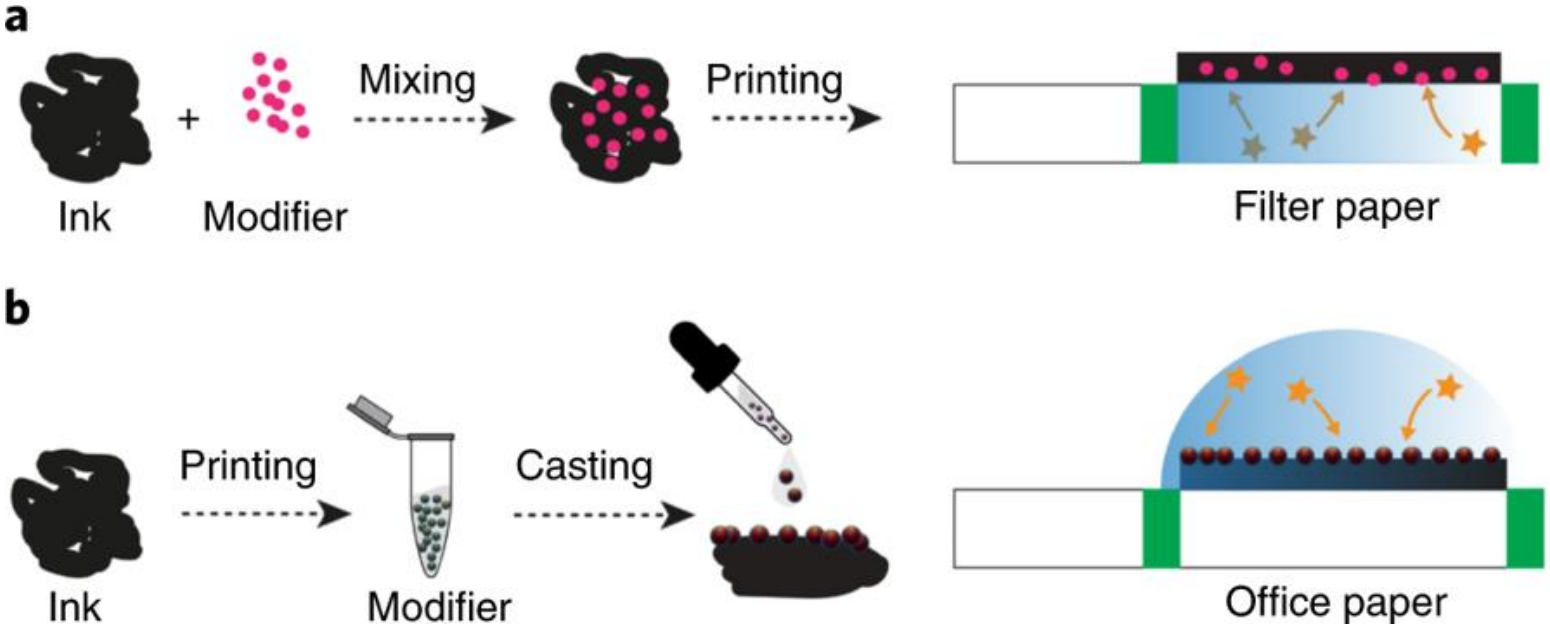
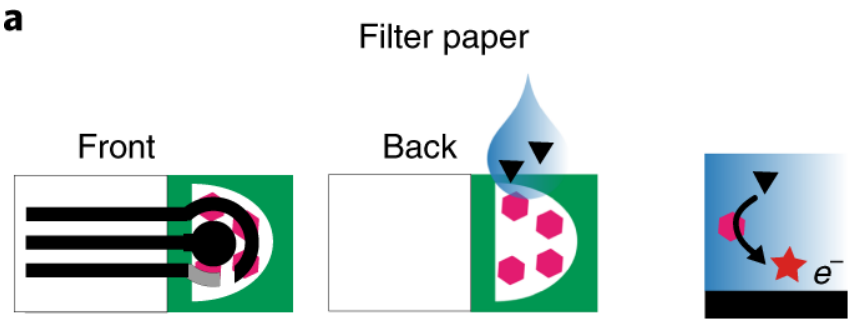


Fig. 3: Enhancing the electrochemical properties of the paper-based devices (10-15 min).

Modifier	Application (used in the analysis of)
Au, AuNPs	As, Hg, Cu
Ag, Ag NPs	Halides
Bismuth film	Pb, Cd, Zn
Prussian blue	Hydrogen peroxide, thiols
Cobalt phthalocyanine	Pesticides
Graphene, carbon nanotubes, carbon black	Ascorbic acid, phenols
Conductive polymers	pH

Making the paper-based electrochemical device reagentless. (5-10 min)

a) 1D filter paper device- Direct detection of analyte

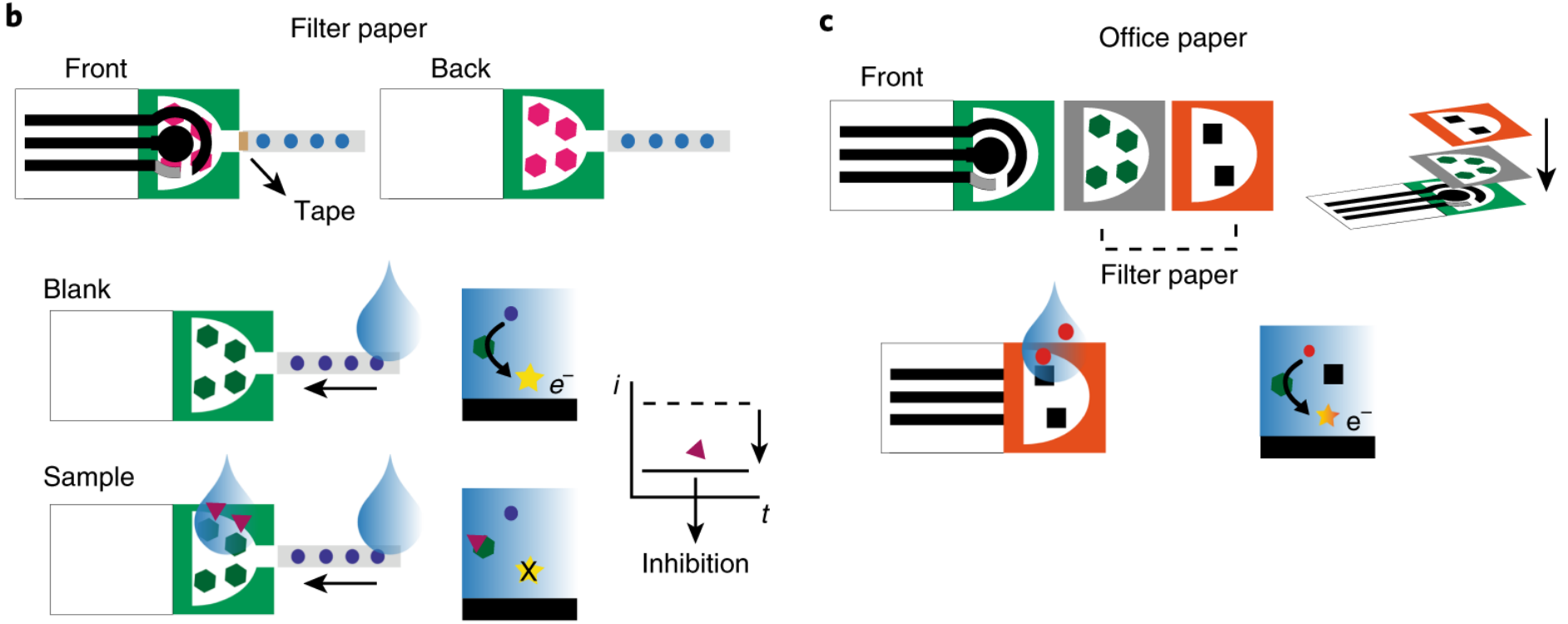


Detection of phosphate ions at a carbon black–modified electrode
Reagents:

- molybdate ions (to react with phosphate),
- sulfuric acid (to make the solution acid),
- potassium chloride (to provide electrolyte for electrochemical measurement).

b) 2D filter paper device

c) 3D office/filter paper device



Biosensor for organophosphate detection e.g. Paraoxon-ethyl (inhibits BChE)

Reagents:
enzyme (BChE),
enzymatic substrate (butyrylthiocholine chloride),
buffer solution (phosphate buffer

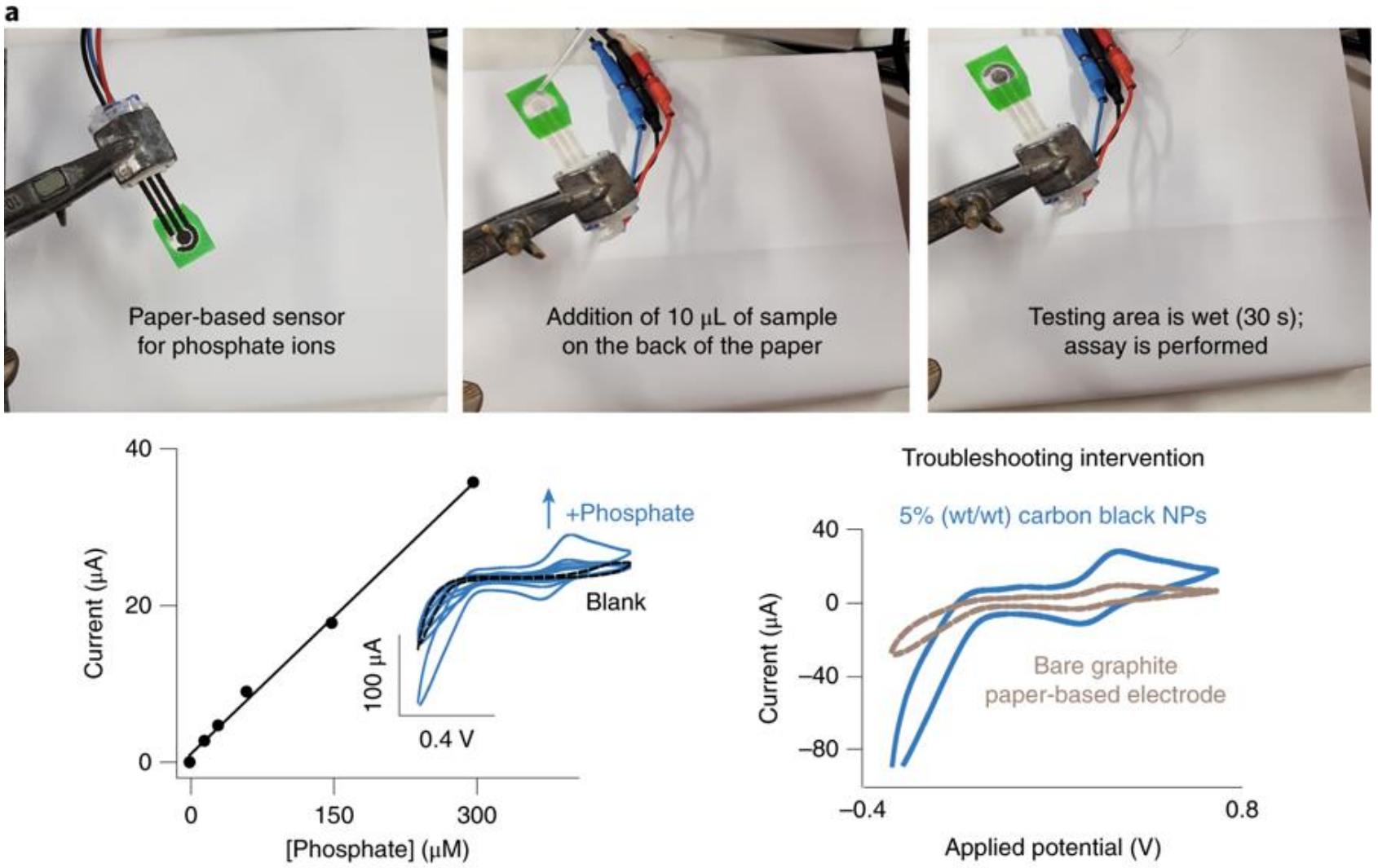
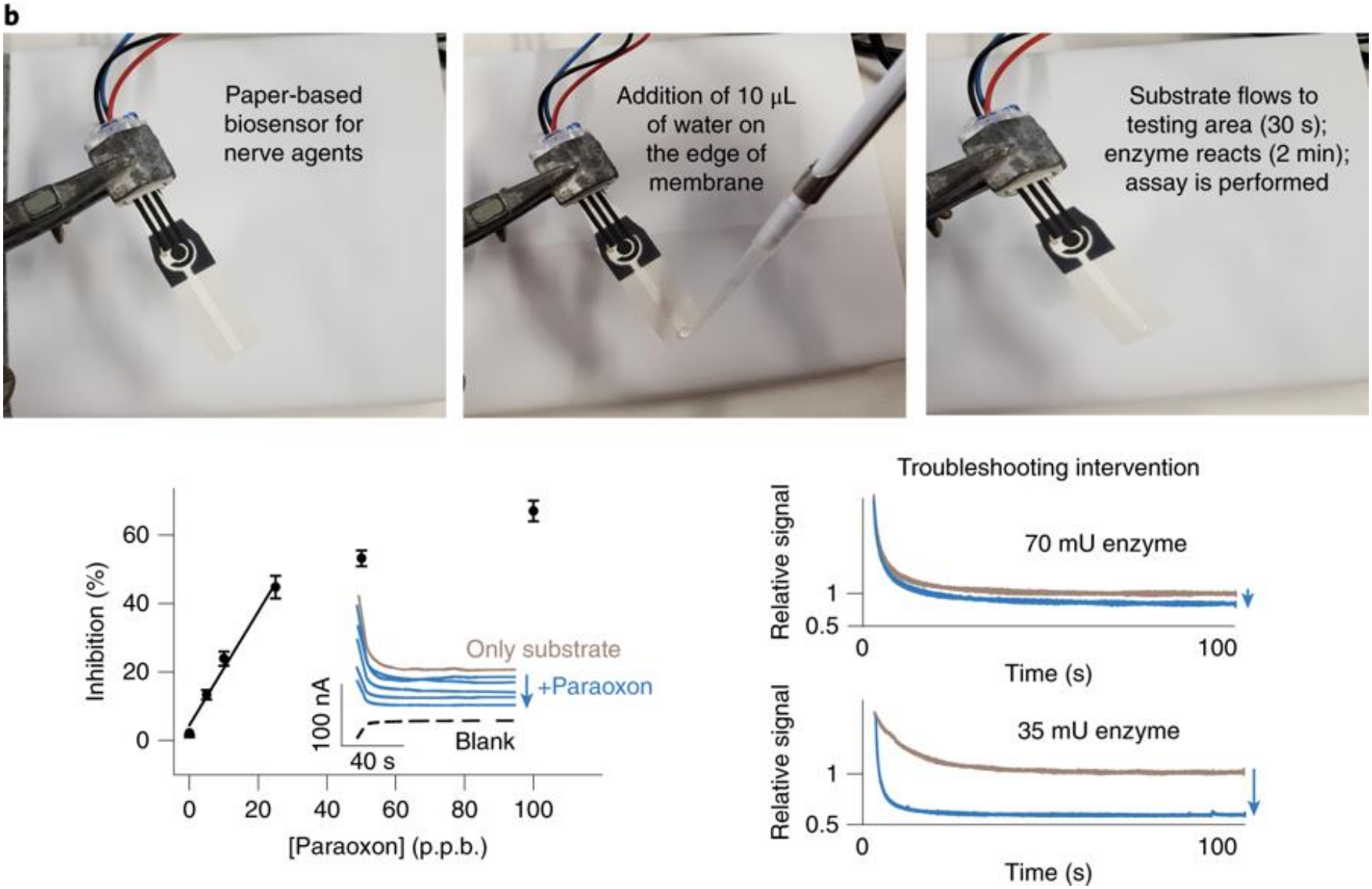


Fig. 5: Photographs of the end products, expected results, and troubleshooting interventions.



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