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Paper-based organic electrochemical transistor array for multi-analyte detection

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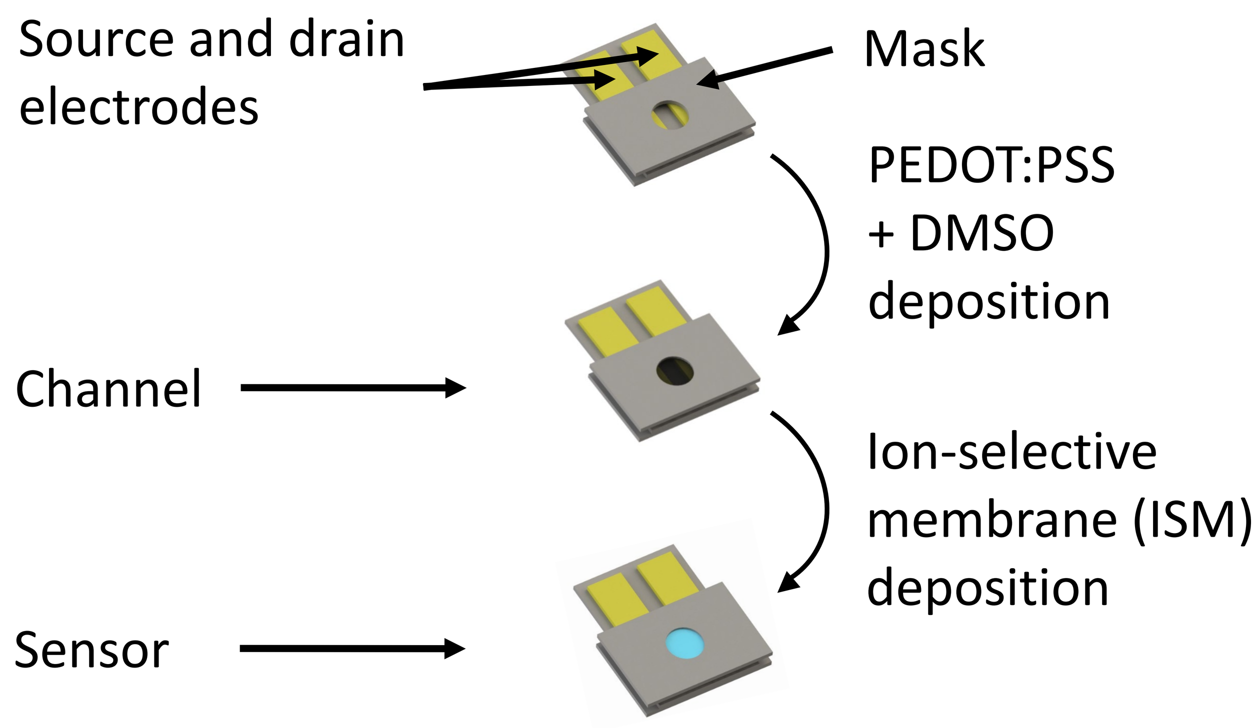
INTRODUCTION

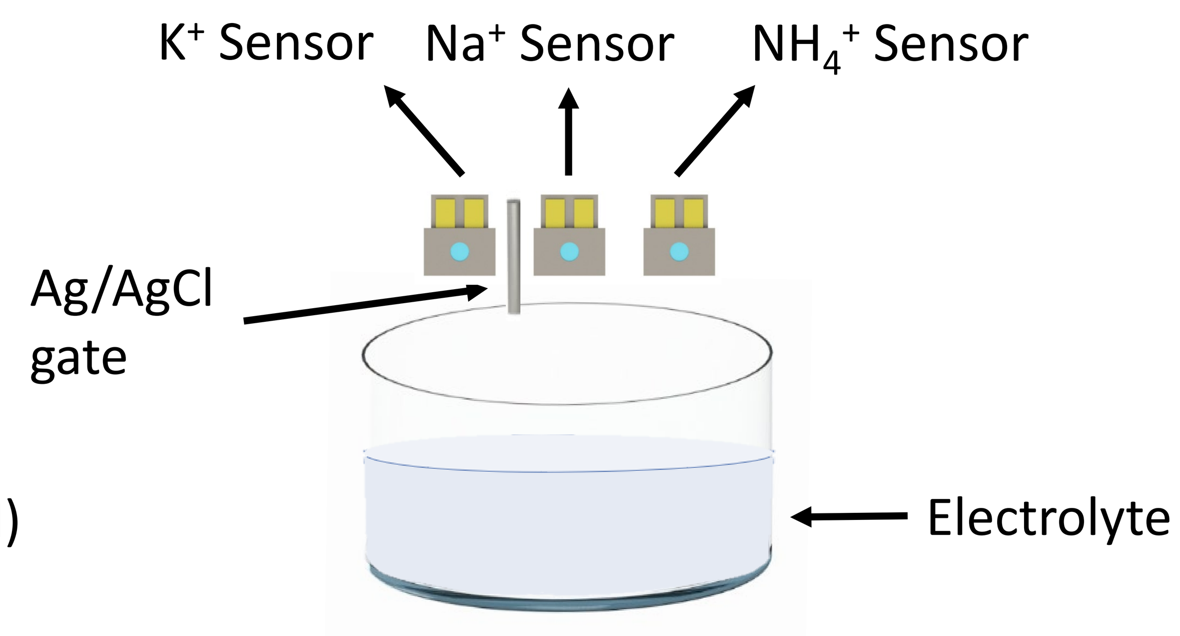
In recent years, organic electrochemical transistors (OECTs) using poly-(3,4-ethylenedioxythiophene) polystyrene sulfonate (PEDOT:PSS), a p-type organic semiconductor polymer, have emerged as a promising alternative due to their–high-amplification capacities, robust analytical performance and versatility.[1,2] The present work proposes a compact multi-analyte transistor array with outstanding analytical performance. Ion-selective organic electrochemical transistors (IS-OECTs) were developed by combining the thick-film technology with the optimum ion-selective membrane.[3] The application of multivariate calibration models enhances the analytical performance, allowing the detection and quantification of ions of interest in complex matrices with interfering potentials.[4] A single gate for three transistors enables the miniaturization of the set-up.

EXPERIMENTAL WORK

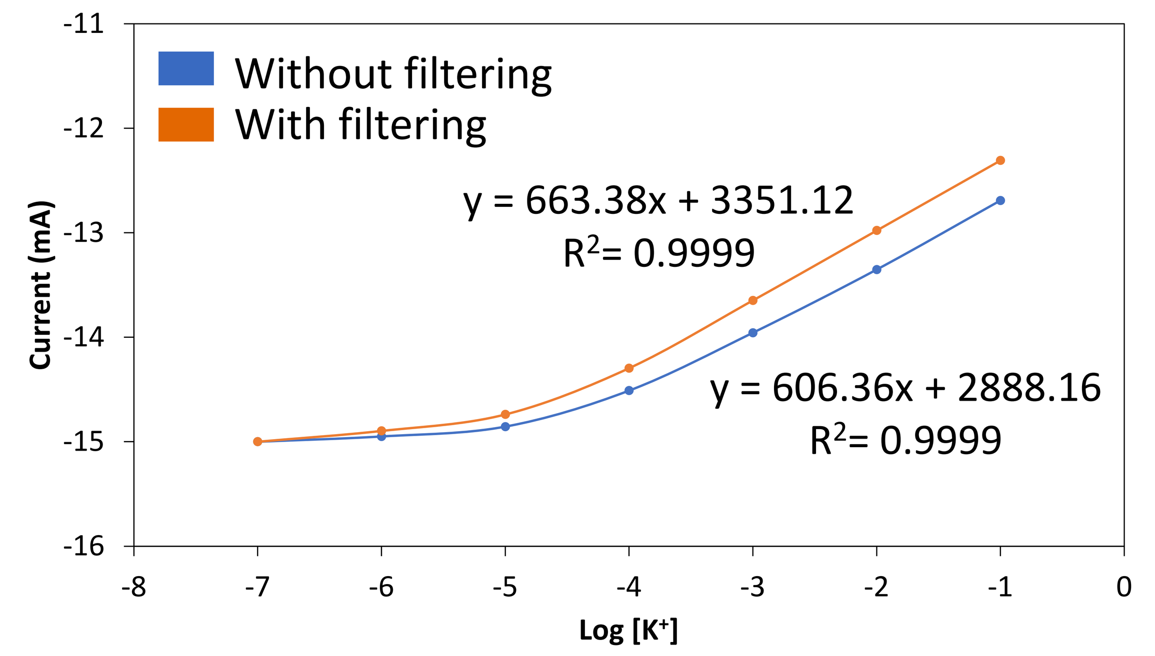
1. Sensor construction



2. Schematic of the measurement cell



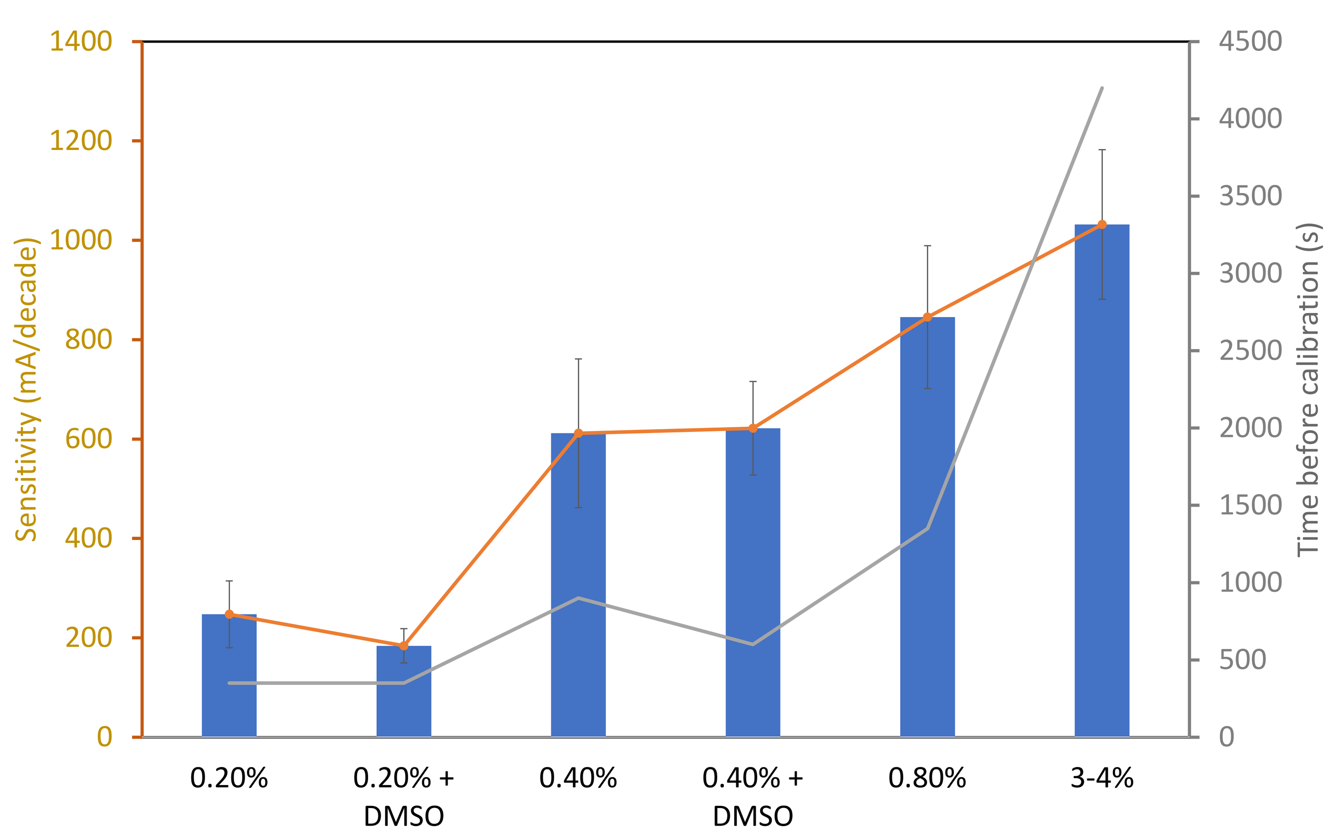
3. PEDOT conditions



- The removal of PEDOT aggregates through filtration allows to improve the analytical performance of the sensor.

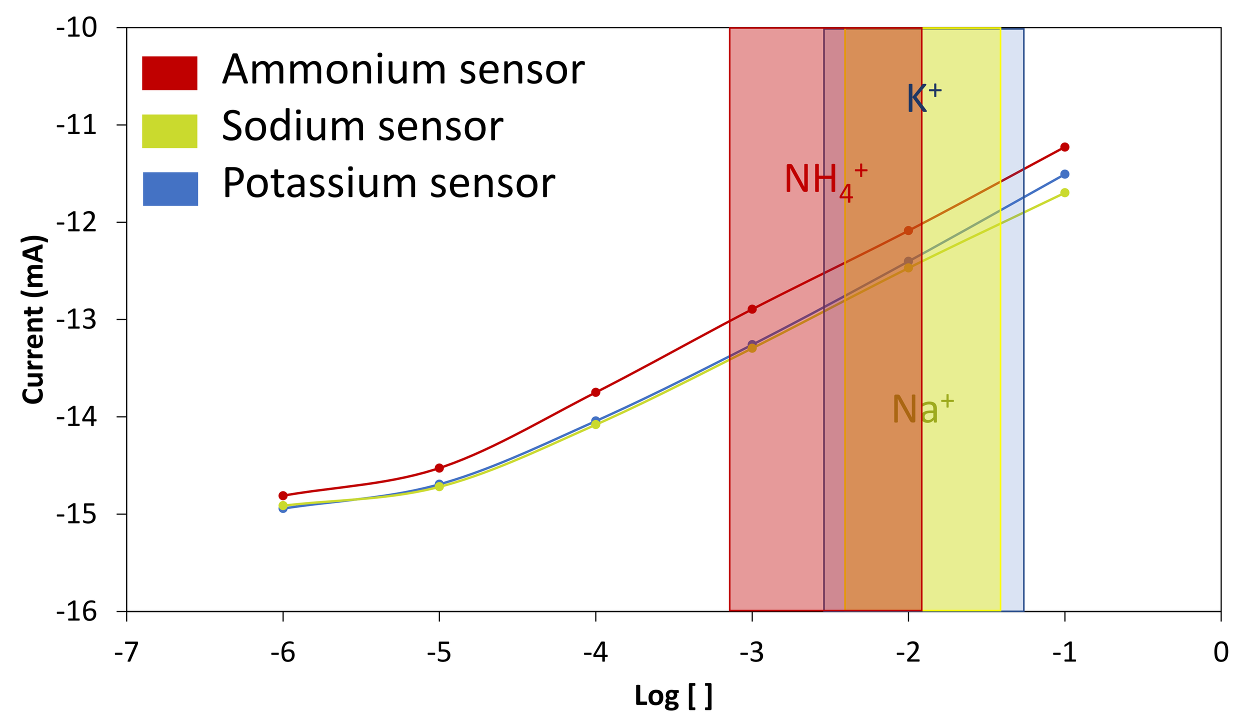
RESULTS AND DISCUSSION

4. Analytical performance



- The increase in concentration of PEDOT produces an improvement in the analytical performance of the sensor in terms of sensitivity.
- DMSO reduce the time before calibration and the variability between sensors.

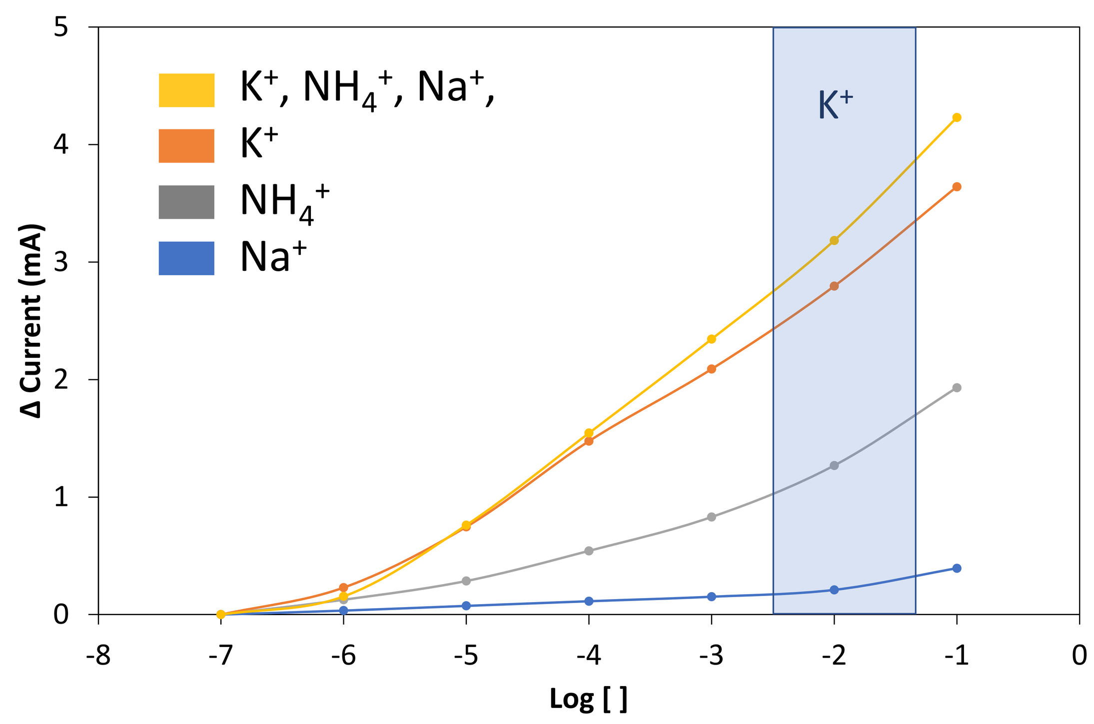
5. Range of interest in human saliva



- All three sensors are linear in the range of interest.

Analyte	Range of interest (mM)
NH_4^+	0.8 – 12.3
Na^+	4.0 – 37.0
K^+	2.6 – 51.2

6. Potassium sensor selectivity



- Data processing through chemometrics is required for selective detection and quantification.

CONCLUSIONS

- ✓ Affordable, sensitive, rapid, robust and reproducible paper-based transistors.
- ✓ Sensor analytical performance depends on the concentration of PEDOT:PSS.
- ✓ Sensors allow to discriminate ions with similar atomic radius and lipophilicity.
- ✓ Multiplex ion sensing using different ISM and a single gate.

FUTURE WORK

- Multivariate model creation to selectively detect and quantify the different ions in presence of interferences.
- Validation of the model with real samples.

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