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Assessing the response of organic electrochemical transistors for sensing applications in biological fluids

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Owing to their nature of amplifying ionic-electronic transducers, organic electrochemical transistors (OECT) are currently the subject of intense scientific investigation in the view of their application in the bio-sensing field[1]. In order to demonstrate this appealing perspective, however, a number of issues should be still addressed through the OECT response analysis when in combination with real biological fluids and the related molecular content.

In this contribution, we will report firstly the results of recent experiments where, under the gating of un-functionalized gold (Au) and platinum (Pt) gate electrodes, PEDOT-PSS-based OECT were operated in contact with human blood, plasma and an alternative isotonic buffer solution containing RBCs in suspension[2]. While the OECT behavior with the Pt gate was found to be completely dominated by the plasma ionic concentration, distinctive features in the steady state and transient responses were identified for blood and plasma under Au gating. Moreover, by isolating and suspending RBCs in an anticoagulant buffer (ACD) supplemented with Albumin, we found that RBC concentration affects the OECT response in terms of the final trans-conductance values extracted from transfer curves (Fig.1).

The role of the negative charges distributed on the RBC surface was tentatively invoked to explain these features. By optical microscopy, finally, no RBC lysis or other morphological alterations were observed after OECT analysis. In a second set of experiments, the response of Aerosol Jet-printed OECT in presence of either reduced (free) and oxidized Homocysteine (Hcy)-based solutions was analyzed[3]. Hcy is a non-protein, sulfur-containing amino acid, recognized as a prothrombotic risk factor when its levels in the blood serum/plasma exceed the normal range between 5 and 12 μM/L (hyperhomocysteinemia). In our study, two experimental protocols were followed: the former relying on gold (Au) electrodes' biothiol-induced thiolation, while the latter simply using bare platinum (Pt) electrodes in the presence of albumin-bound Hcy, with this being, physiologically, the most abundant oxidized Hcy-form in circulation. OECT were found to display final limit of detection (LoD) values of 80 nM and 180 nM, respectively, for Au- and Pt-gated devices. As a whole, in view of suitable biochemical functionalization protocols supporting the selectivity response for various analytes, these results achieved with bare gate electrodes are useful to define the main OECT operational

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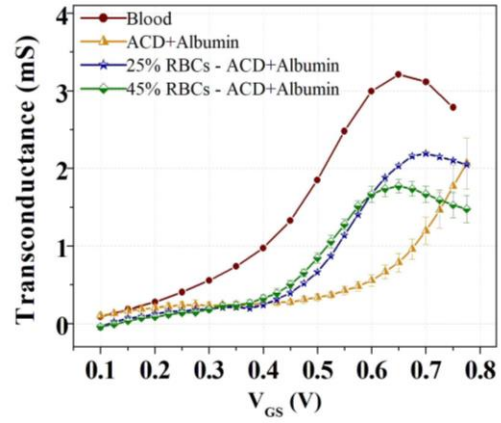

Fig.1 Tranconductance (g_m) values extracted from OECT transfer curves (V_{DS}=-0.1V) measured in whole blood, ACD plus albumin and RBCs at 25% and 45% (this value corresponding to the hematocrit in the blood) in ACD plus

features in the discussed complex matrices and represent a starting reference for following experiments based on differential measurement approaches.

References

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