Highlights

RESEARCH AREA 2 - **Functional and Complex Materials for Innovative Electronics and Sensing** - 2022

"Organic electrochemical transistors as novel biosensing platforms to study the electrical response of whole blood and plasma"

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In this paper, for the first time, organic electrochemical transistors (OECTs), based on PEDOT:PSS active channels and driven by gold or platinum gate electrodes, were employed to investigate the electrical behaviour of human blood, plasma and alternative buffer solutions that inhibit red blood cell (RBC) aggregation. While the OECT response with the platinum gate was found to be completely dominated by the strong ionic concentration related to plasma, with gold electrodes we identified distinctive features of the steady state and transient OECT behaviour in blood and plasma. In a second set of experiments, we observed a clear dependence of the OECT response, in terms of the current modulation and the trans-conductance values as extracted from the transfer curves, on the concentration of RBCs suspended in Anticoagulant Citrate Dextrose (ACD) solutions supplemented with albumin. The role of negative charges distributed on the RBC surface was considered to explain the main findings observed in this study. Finally, RBC morphology was monitored just after the withdrawal and during the electrical experiments, with optical microscopy observations showing that the application of voltages lower than 1 V does not provide significant cell lysis or other structural modifications. Overall, this study demonstrates that OECTs can be applied as non-destructive analysis tools in combination with blood-based solutions.

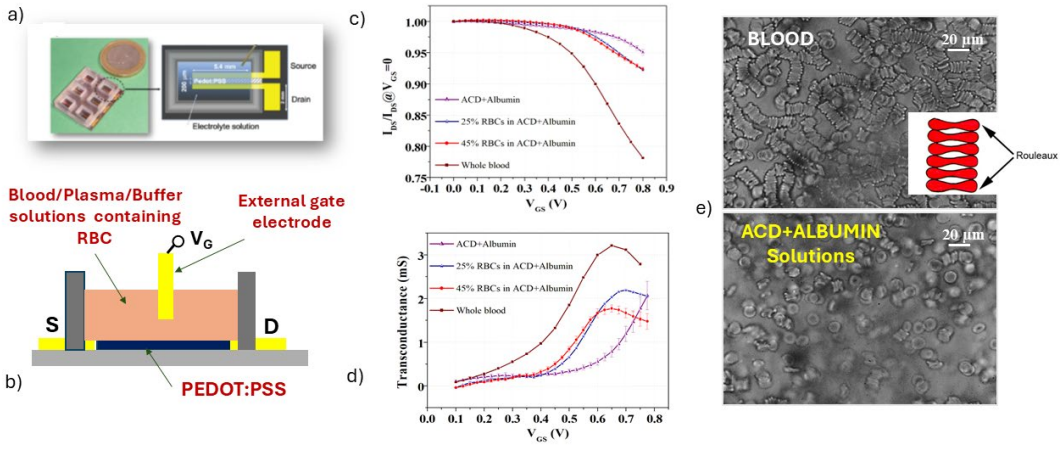

Fig. 1: a) Layout of the PEDOT:PSS OECTs; b) A schematic side view of the device configuration; c) OECT normalized transfer-curves (V_{DS}=-0.1V) and (d) transconductance values as a function of V_{GS} achieved for whole blood, ACD plus albumin, and RBCs at 45% and 25 % in ACD plus albumin; e) RBC morphology observed after the electrical tests in blood and ACD plus albumin solutions.