Gating Organic Electrochemical Transistors with Ti_3C_2 MXene Electrodes

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Organic Electrochemical Transistors (OECTs) have found applications as a novel tool for the detection of different biological analytes, such as proteins and nucleic acids. [1-2] While the suitability of these devices for biosensing applications has already been demonstrated, there is still the need to develop new strategies to make OECTs-based sensors always more sensitive and reliable. To this aim, in this work an OECT made of Poly[3-(5-carboxypentyl)thiophene-2,5-diyl] (P3CPT) was gated with a Ti_3C_2 MXene electrode and its performance compared with two electrodes largely exploited in literature, such as Au (gold) and Ag/AgCl (silver chloride). Electrical characterizations were performed exploiting a customized microfluidic cell to measure the three electrodes on the same chip, thus ensuring the same measurement conditions. [3] The experimental results showed outstanding performance of the OECT when operating with a MXene gate electrode, whose average transconductance resulted to be 60% and 80% greater than Au and Ag/AgCl respectively with the same bias conditions (see Figure 1). The much greater transconductance obtained from the MXene gate is partially compensated by the greater threshold voltage, which eventually make the maximum current of the same order of magnitude than Au gate. Much worse performance were recorded with the Ag/AgCl, which however showed a better stability over several measurement cycles.

These preliminary results suggest that MXenes can be successfully exploited to make OECTs with enhanced transconductance compared to more conventional electrodes, which is of paramount importance to make highly sensitive devices. Further work on the subject will focus on the bias stability and MXene material characterization to assess the origins of its outstanding performances.

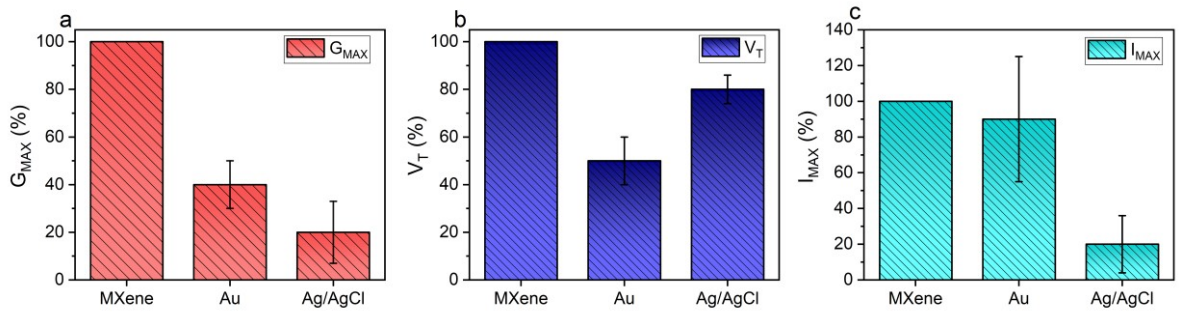

Figure 1. Percentage variation of the transconductance (a), threshold voltage (b) and maximum current (c) of the OECT gated with MXene, Au and Ag/AgCl. All the values were normalized to the MXene gate.

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