



European Materials Research Society

2025 Spring Meeting

May 26 - 30

Strasbourg Convention Centre

www.european-mrs.com



15_2260 Non-Ideal Nernstian Behavior in Organic Electrochemical Transistors: Fundamental Processes and Theory

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Abstract

Despite the successful implementation of Organic Electrochemical based devices (OEDs), fundamental processes that regulate their operations and sensing capabilities, specifically those related to ion-to-electron transduction, remain unclear. Indeed, there is still a lack of fundamental models to explain the steady-state and transient characteristics of OEDs, associating fundamentals of the physical-chemistry of the pair polymer-electrolyte with the output performance of such devices. In this study, we bring new highlights to a thermodynamic-based model that qualitatively and quantitatively describes OEDs operation, with a special focus on the Organic Electrochemical Transistor (OECT). In this context, we introduce novel interpretations for traditional drain current models, grounded in thermodynamic and electrochemical principles. The model fitting parameters are correlated to the physical and chemical properties of the polymer-electrolyte pair, and it has been shown to explain trends observed in experimental results from the literature. Moreover, our model reveals that a non-Nernstian electrochemical behavior dominates OECT operation. Also, by analyzing experimental data, we are able to generate guidelines for material design and device development, targeting highly sensitive electrochemical biosensors and devices.