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Electrolyte-Gated Organic Field-Effect Transistors-Based Biosensors: Towards the Development of All-Printed Portable Devices

Electrolyte-Gated Organic Field-Effect Transistors (EGOFET) are a subset of organic transistors in which the capacitive coupling between the gate electrode and the organic semiconductor is achieved through an electrolyte. The intrinsic presence of a liquid within their structure as well as the low biasing voltages (< 1 V) make these devices ideal candidates for the development of biosensors in liquid media.[1] In this talk, the structure and working principle of EGOFET will be described. A semi-quantitative EGOFET model, based on the Nernst-Planck-Poisson equations and treating on equal footing the semiconductor and the electrolyte, will be also presented.[2] Some examples of functionalisation strategies to make the devices able to detect and quantify target biological molecules (diclofenac, metal ions)[3,4] or even real-time monitoring of living organisms[5] will be provided. Finally, a fabrication protocol exclusively based on inkjet-printing will be illustrated.[6]

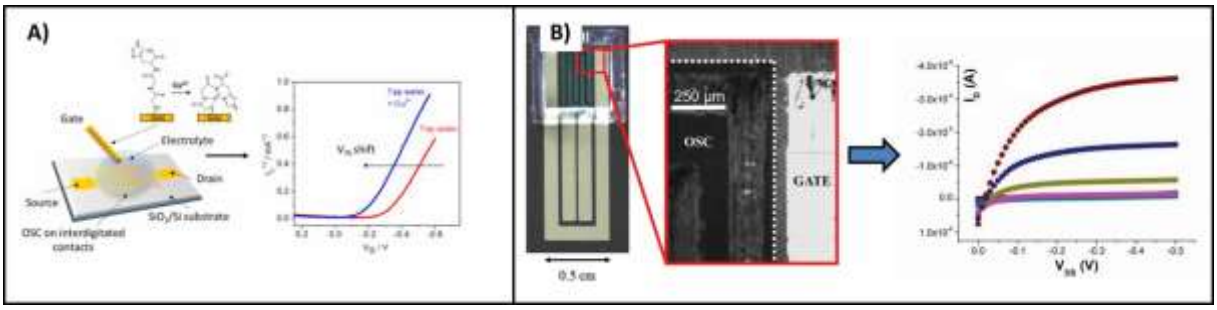

Figure 1. A) Functionalisation strategy of the gate electrode for the detection of Cu^{2+} ions [4]. B) Optical image of an all-inkjet-printed EGOFET and its corresponding output curves [6].

[1] Wang, D.; Noël, V.; Piro, B. *Electrolytic Gated Organic Field-Effect Transistors for Application in Biosensors—A Review*. Electronics 2016, 5, 9. https://doi.org/10.3390/electronics5010009

[2] Delavari, N. ; Tybrandt, K. ; Berggren M.; Piro B.; Noël V.; **Mattana G.**; Zozoulenko I. *Nernst–Planck–Poisson analysis of electrolyte-gated organic field-effect transistors.* J. Phys. D: Appl. Phys. 2021, 54, 415101. https://doi.org/10.1088/1361-6463/ac14f3

[3] Nguyen, T. T. K.; Vu, T. T.; Anquetin, G. ; Tran, H. V.; Reisberg, S.; Noël, V.; **Mattana, G.**; Nguyen, Q. V.; Lam, T. D.; Pham, M. C.; Piro, B. *Enzyme-less electrochemical displacement heterogeneous immunosensor for diclofenac detection*, Biosens. Bioelectron. 2017, 97, 246. https://doi.org/10.1016/j.bios.2017.06.010

[4] Nguyen, T. T. K.; Tran, H. V.; Vu, T. T.; Reisberg, S.; Noël, V.; **Mattana, G.**; Pham, M. C.; Piro, B. *Peptide-modified electrolyte-gated organic field effect transistor. Application to Cu^{2+} detection.* Biosens. Bioelectron. 2019, 127, 118. https://doi.org/10.1016/j.bios.2018.12.005

[5] Le Gall, J.; Mouillard, F.; Le, T. N.; Vu, T. T.; Mattana, G.; Brayner, R.; Zrig, S.; Noël, V.; Piro, B. *Monitoring photosynthetic microorganism activity with an electrolyte-gated organic field effect transistor.* Biosens. Bioelectron. 2020, 157, 112166. https://doi.org/10.1016/j.bios.2020.112166

[6] Chennit, K.; Delavari, N.; Mekhmoukhen, S.; Boukraa, R.; Fillaud, L.; Zrig, S.; Battaglini, N.; Piro, B.; Noël, V.; Zozoulenko, I.; Mattana, G. *Inkjet-Printed, Coplanar Electrolyte-Gated Organic Field-Effect Transistors on Flexible Substrates: Fabrication, Modeling, and Applications in Biodetection*. Adv. Mater. Technol. 2023, 8(2), 2200300. https://doi.org/10.1002/admt.202200300