Organic Electrochemical Transistors for sensing Applications
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In the last decades organic semiconductors have attracted enormous interest for fabrication of devices for low-cost flexible electronics, such as light emitting diodes, transistors and solar cells. A more recent development in the field involves the use of organic electronics devices in sensing applications. In this context, organic electrochemical transistors (OECTs) represent a very attractive class of devices. OECTs can be operated in aqueous environment as ion to electron converters, thus providing an interface between the world of biology and electronics. This property, together with the well-known advantages or organic devices such as low cost and flexibility, makes OECTs the ideal devices for sensing applications. In addition, OECTs represents model system to explore fundamental properties of organic electronics devices exhibiting mixed ionic/electronics conduction. Despite the significant progresses in the field of sensors based on OECTs, the understanding of the basic physics and the working principle of these devices are still limited. Efforts in these directions, besides their fundamental interest, are needed to design and engineer of specific material and devices, which would make OECTs sensor competitive with other well-established sensing technologies.

We addressed this issue studying the role of device geometry on the electrical properties of sensors based on OECTs. As the model analyte for our studies we chose hydrogen peroxide, a species frequently detected in enzymatic sensing. We demonstrated that the sensitivity and the signal-to-noise ratio of OECTs sensors depend on the ratio between the double layer capacitances at the electrolyte/channel (Cch) and at gate electrode/electrolyte (Cg) interfaces. Our best devices were able to detect sub-micromolar H2O2 concentrations, a value consisting with clinical glucose levels found in human saliva.