Layered Double Hydroxide-Modified Organic Electrochemical Transistor for Glucose and Lactate Biosensing

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Abstract

Organic Electrochemical Transistors (OECTs) offer consistent advantages in the fabrication and development of sensors. Easy and cheap readout electronics, low supply voltage (usually < 1 V), low power operation (< 100 μW), biocompatibility, and ease of integration in unconventional substrates are winning points of these devices. Moreover, the transistor configuration provides intrinsic amplification of the output signal that can be exploited for the fabrication of biosensors with boosted performances1.

This contribution describes OECT-based biosensors for the non-invasive and selective detection of glucose and lactate2 in biofluids. The channel of the transistor is made of the organic semiconductor poly(3,4-ethylenedioxythiophene):poly (styrene-sulfonate) (PEDOT:PSS). The gate electrode is functionalized with glucose oxidase or lactate oxidase, which are immobilized within a Ni/Al Layered Double Hydroxide through a one-step electrodeposition procedure. Both elements are immersed in an electrolytic solution and the voltage applied to the gate electrode controls the current that flows in the channel through the occurrence of electrochemical processes involving the analytes. The devices can detect target compounds because the chemically-modified gate electrodes mediate their oxidation varying the current flowing into transistor. The amperometric current that is at the basis of transduction is amplified by the transistor architecture and the signal recorded at the drain can be enhanced 400 times. The biosensor detects glucose in the concentration range of 0.1–8.0 mM with a limit of detection (LOD) of 0.02 mM. For lactate, the biosensor response is linear in the whole concentration range (0.05–8.0 mM) with a LOD value of 0.04 mM.

Biography:

Isacco Gualandi graduated in Industrial Chemistry summa cum laude in 2009 and he got his PhD degree in Chemical Sciences in 2013 at the Bologna University. After a period of post-doctoral fellowships at the Departments of Physics and Astronomy and Industrial Chemistry, he is now working as a researcher in Analytical Chemistry at Bologna University. His research activity focuses on the development of innovative electrochemical sensors based on both inorganic and organic materials..

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