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Carnitine tailored Sensors on Surface Molecular Imprinting based on Graphene layers

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A new biosensor based on surface molecularly imprinted polymer (MIP) on graphene layers was successfully developed. It consists in a 3D polymeric network created on top of surface and around the target template, Carnitine (CRT), a potential biomarker of ovary cancer. The polymeric structure was obtained after radical polymerization of (vinylbenzyl)trimethylammonium chloride, 4-styrenesulfonic acid and vinyl pivalate, including in the reaction mixture ethylene glycol dimethacrylate as cross-linker and ammonium persulphate as initiator. Non-imprinted polymer (NIP) material was also produced, by excluding the template from the procedure.

The imprinted graphene structures were further used for the selective determination of CRT by potentiometric transduction. For this purpose, a selective membrane was prepared by using the MIP material as ionophore, and dispersing it in a plasticized poly(vinylchloride) matrix, that included (or not) a suitable amount of charged lipophilic additive. The membranes were casted over a solid conductive support, made of graphite or of conductive glass. Control membranes were also produced by replacing MIP by NIP material.

The potentiometric performance of the above electrodes was assessed against CRT solutions of increasing concentrations. Graphite supports displayed the best analytical features, with average slope and detection limit of 40.51 mVdecade⁻¹ and 3.55x10⁻⁶ molL⁻¹, respectively. The effect of pH upon the potentiometric response was evaluated for different buffer solutions (within 2-9) and the best performance for this sensor was obtained with HEPES (4-(2-hydroxyethyl)-1-piperazineethanesulfonic acid) buffer of pH 5.2. The interference effect of albumin, ascorbic acid, glucose, creatinine and urea in the performance of the electrochemical unit was tested for concentrations up to their normal physiologic levels in urine and good selectivity was observed. The application of the devices to the analysis of spiked samples showed recoveries ranging from 91% (± 6.8%) to 118% (± 11.2%), with relative errors below -20%.

Overall, the combination of the MIP sensory material with a suitable selective membrane and electrode design showed to be a promising tool for point-of-care applications.

Keywords: Carnitine; Surface Molecularly imprinted sensors; Graphene; Solid conductive supports; Potentiometry.