

Book of Abstract

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Design of ZnO nanostructures for the Electrochemical Sensing of Creatinine in Aqueous solution

Vincenzo Piscopo,¹ Giorgia Puleo,¹ Claudia Pellerito,¹ Bruno Pignataro,¹ Valeria Vetri,¹ Giuseppe Arrabito¹

¹ Department of Physics and Chemistry- Emilio Segrè, University of Palermo, Viale delle Scienze 17, 90128 Palermo, Italy.

vincenzo.piscopo@you.unipa.it

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Creatinine (CRE) is a metabolic waste product generated in the human body, whose detection is crucial for assessing an individual's health status. By measuring the concentration of CRE in body fluids, it is possible to diagnose potential renal dysfunctions and prevent complications arising from the onset of diseases. [1] Currently, CRE is detected through well-established analytical methods, such as colorimetric techniques (e.g., Jaffe method) or enzymatic methods. However, these approaches suffer from narrow concentration range, susceptibility to degradation, and high costs. [2] In this context, non-enzymatic sensors (NES) represent a viable alternative, offering advantages such as good stability after repeated use, high selectivity, and reduced costs depending on the materials used. [3] In this study, a sensor for CRE has been designed based on its interaction with zinc-based compounds, which can be detected using electrochemical methods. Specifically, a ZnO/ITO/PET-based sensor was synthesized following a previous protocol outlined in a recent study on smart wearable devices. [4] The sensor detection was obtained using a three-electrode electrochemical cell in a working solution containing the redox couple 1 mM $[\text{Fe}(\text{CN})_6]^{3-/4-}$. Cyclic voltammetry was performed on this setup to assess the reversibility of the redox phenomena occurring on the WE surface, while electrochemical impedance spectroscopy (EIS) measurements were carried out with increasing concentrations of CRE ($10\mu\text{M} < [\text{CRE}] < 100\mu\text{M}$). The analysis of the Nyquist plots showed that the R_{cp} values, obtained through a Randles circuit, in relation to the concentration of CRE in solution, in accordance with previous results. [5] The interaction between the target molecule and the ZnO sensor surface could be attributed to the material's surface morphology, providing a large surface area for CRE adsorption and/or to the formation of Zn^{2+} -CRE complexes [5], which may in proximity to the sensor surface due to the release of Zn^{2+} ions into the solution. Future experiments could aim to better understand the nature of this interaction. It is also important to evaluate how potential physiological interferents might alter the instrumental responses, to assess the sensor's selectivity. Additionally, the piezoelectric properties of ZnO are being studied to improve the sensitivity in the detection of CRE and other analytes of similar nature and significance. This type of research will be crucial in the development and implementation of point-of-care devices.

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