PÔSTER - RESUMO - SENSORES E BIOSSENSORES

DIFFERENTIAL ELECTROCHEMICAL IMPEDANCE ANALYSIS AS A DIAGNOSTIC AND CALIBRATION TOOL FOR INTERDIGITATED ELECTRODES

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Advances in microfabrication techniques have enabled the large-scale production of microstructures with standardized dimensions. This has popularized the commercialization of interdigitated electrode (IDE) kits at an affordable cost. The micrometric spacing between the IDE tracks allows for current detection even in resistive media, enabling its use in impedimetric applications such as biosensors and conductivity meters [1]. To be used as a conductivity sensor, the IDE's cell constant must be known so that the measured resistance can be converted into a conductivity value for the medium being characterized. The cell constant of IDEs can be theoretically determined by the conformal mapping method, based on their geometric dimensions (number of tracks, their length, width, and spacing between them). The experimental determination of the cell constant requires the use of electrolytic solutions with standardized conductivity. However, the experimental values are on average about 30% below their theoretical values [2]. The discrepancy between theory and experiment can have two origins. The first cause relates to

edge effects that generate a large distortion of the field lines, which affects the experimental value of the cell constant. The second cause is due to the growth of a spurious film on the IDE, of unknown nature, but with semiconductor electrical properties that end up completely altering the impedimetric response of the IDE [3]. The primary objective of this work was to determine the cell constant of Dropsens/Metrohm gold interdigitated electrodes (IDEAU50). To this end, the impedance of electrolytic solutions of different concentrations, measured with the IDE and with a calibrated conductivity cell, were compared. The resistance of the solution in both cases was extracted using the generalized phase element (GPE) method [4]. Some IDEs exhibited anomalous behavior, showing resistance values much higher than expected, which were attributed to the growth of a resistive film on the tracks. Thanks to the GPE method, it was found that the same electrodes also presented electrical double-layer capacitances in the nF cm-2 range, typical values for semiconductor materials. This work is still under development, but preliminary results indicate that, after discarding the low-capacitance IDEs, there is excellent agreement between the theoretical and experimental values of the cell constant. In short, GPE analysis of interdigitated electrode impedance data has two uses: (i) the capacitance values, which are extracted from the GPE analysis without frequency dispersion, can be used to diagnose the quality of the electrode gold tracks; (ii) the resistance values, which are also determined without dispersion, correspond to the expected theoretical value, which theoretically eliminates the need for experimental electrode calibration.

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Palavras-chave: electrochemical impedance spectroscopy; generalized phase element; interdigitated electrodes; conductivity cell.