PÔSTER - RESUMO - SENSORES E BIOSSENSORES

LOW-TEMPERATURE ELECTRODEPOSITED TIO_2 ON GRAPHENE FOAM FOR ENHANCED PHOTOELECTROANALYSIS

Jose Luiz Bott Neto (joseluiz.bott@gmail.com)

Thiago Serafim Martins (thiagoserafimartins@gmail.com)

Osvaldo De Oliveira Junior (chu@ifsc.usp.br)

Light-activated electrochemical sensors have emerged as powerful tools in the field of biosensor development, offering significant potential for applications such as clinical diagnostics and environmental monitoring. Their ability to combine electrochemical detection with photoinduced charge generation enables improved sensitivity, lower background signals, and enhanced analytical performance [1]. In this context, semiconductor-based photoelectrodes have attracted increasing attention, particularly titanium dioxide (TiO2), due to its chemical stability, low cost, and favorable photoelectrochemical properties. This study investigates the photoelectroanalytical response of TiO2-based electrodes prepared by low-temperature electrodeposition onto graphene foam (GF), without the need for thermal annealing. The elimination of post-deposition heat treatment is especially relevant for carbon-based substrates, which can suffer structural degradation at high temperatures. The performance of TiO2 deposited on GF was compared with that of homemade electrodes fabricated using carbon nanoparticle ink (CNPs). Electrodeposition parameters, including temperature and pH, were systematically optimized to obtain films with improved morphological and electrochemical characteristics. Photoelectrochemical

experiments were carried out using a portable system constructed according to the methodology described by Bott et al. [2]. Under optimized conditions, the TiO2-10/GF platform (10 minutes of electrodeposition) exhibited a significantly enhanced photocurrent density of 170 μA / cm². This value is approximately 2.1 times higher than that obtained for TiO2-10/CNP electrodes (82 μA / cm²) in the presence of 0.1 M ascorbic acid used as a redox probe. The superior performance of the GF-based electrodes is attributed to their highly porous morphology and larger effective surface area, which facilitate improved light harvesting, enhanced charge separation, and more efficient photoelectrocatalytic activity. The three-dimensional graphene structure also promotes better electron transport, contributing to the amplified photocurrent response. Overall, these findings demonstrate that TiO2-modified graphene foam represents a promising platform for high-performance photoelectrochemical devices. The significant improvement in photocurrent density highlights its potential for portable biosensing applications and energy conversion systems, surpassing conventional carbon-based electrodes. The proposed strategy offers a scalable and thermally compatible approach for the development of next-generation photoelectroanalytical platforms.

References:

[1] H. Li, W. Sheng, S. A. Haruna, Q. Bei, W. Wei, M. M. Hassan, Q. Chen. TrAC Trends Anal. Chem, 164 (2023) 117108.

[2] J. L. Bott-Neto, W. Leather, M. Gutiérrez, S. Randin, R. Schneider. Sensors and Actuators B: Chemical, 345 (2021) 130390.

Acknowledgments:

The authors acknowledge the financial support provided by INEO, CNPq (408449/2024-1) and FAPESP (2022/03758-0, 2022/15122-3, 2019/13514-9, 2022/00243-0, 2018/22214-6, 2025/27044-5).

Palavras-chave: photoelectrochemical biosensing; titanium dioxide (tio2); graphene foam; low-temperature electrodeposition.