

EFFECT OF ELECTRON MEDIATOR ON NATURAL RUBBER LAYER-BY-LAYER FILMS SENSING PERFORMANCE

Azeneth Borja Brochero (azeneth.borja@unesp.br)

Fellipe Cesar Rodrigues Matheus (fellipe.cesar@unesp.br)

José Antonio Malmonge (jose.malmonge@gmail.com)

Marystela Ferreira (marystela@ufscar.br)

Cibely Da Silva Martin (cibely.martin@unesp.br)

The incorporation of electronic mediators into a polymeric matrix is a crucial strategy for tuning and controlling electrical and optical properties when the material is structured as thin films, thereby enabling promising sensing applications. Natural rubber (NR), composed of long chains of isoprene units linked in a cis-1,4 configuration, is a biopolymer extracted from renewable sources, which makes it particularly attractive for sustainable material applications [1]. The present work aims to optimize the Layer-by-Layer (LbL) deposition process of self-assembled natural rubber films derived from natural rubber latex (NRL), incorporating nickel tetrasulfonated phthalocyanine (NiTsPc) or carbon dots (CDTs) as electronic mediators. The films were assembled onto ITO electrodes using a diluted NRL suspension containing 0.5 mg L⁻¹ of the electronic mediator as the anionic solution and a 0.5 mg L⁻¹ polyethyleneimine (PEI) solution as the cationic counterpart. Film growth was carried out up to 15 bilayers, and electrochemical measurements were performed for films containing 5, 10, and 15 bilayers. The LbL films were characterized by UV-Vis

spectroscopy, atomic force microscopy (AFM), scanning electron microscopy (SEM), and cyclic voltammetry. Morphological analysis revealed a uniform arrangement of spherical particles, attributed to the preservation of NR particles during film formation in the presence of both electronic mediators. In contrast, NR-only films exhibited coalescence of the spherical particles. Cyclic voltammetry results demonstrated that the incorporation of NiTsPc provided higher interfacial conductivity compared to CDts, suggesting greater sensitivity to charge transfer mediated by the phthalocyanine macrocycle. In summary, the molecularly organized NR films incorporating NiTsPc or CDts exhibited promising electrical properties and favorable morphology for application as sensing platforms. Furthermore, the chemical composition of the electronic mediator plays a key role in modulating sensitivity and electrochemical response in sensing applications.

[1] C. R. Cena et. al, Journal of Polymer Research. 2017, 24, pp. 1-7.

Acknowledgement: INEO (FAPESP - processo nº 2025/27044-5 e CNPq - processo: 408449/2024-1). FAPESP 2023/14967-2, 2023/17369-9, CAPES e CNPq.

Palavras-chave: natural rubber; eletron mediator; layer-by-layer; sensing platform.