SANTOS

XXII B-MRS Meeting 2024

September 29th to October 3rd

PROCEEDINGS

Sociedade Brasileira de Pesquisa em Materiais

Proceedings of the XXII B-MRS Meeting

Santos, SP 2024

Conteúdo, revisão textual e gramatical: Resposanbilidade dos respectivos autores.

ISBN: 978-85-63273-63-5

Exploring Photoluminescent Self-Assembled Monolayers on Commercial Glass for Biomedical Detection: A Promising Approach

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Exhaled air, comprising gases, Volatile Organic Compounds (VOCs), and aqueous microdroplets, serves as a critical matrix for detecting lung diseases, including Covid-19. During the onset or resolution of a disease, biochemical processes in the body emit gases and VOCs, which can traverse from the bloodstream to the lung alveoli and subsequently be detected in exhaled air. Gas chromatography plays a pivotal role in this domain due to its capacity to identify, separate, and quantify trace-level gases. However, traditional gas chromatography systems are bulky, lack real-time detection capabilities, and are not easily adaptable to diverse environments.
Therefore, this project aims to develop an optical platform on glassy systems utilizing a strategy of chemical functionalization of Self-Assembled Monolayers (SAMs) for the immobilization of advanced photoluminescent materials such as Lanthanide Complexes and perovskites.
A wide array of techniques, including Single X-ray diffraction, powder X-ray diffraction, Raman Spectroscopy, Transmission Electron Microscopy, and Photoluminescence Spectroscopy, are employed to characterize the materials.
To assess the viability of the synthed materials for detecting VOCs, theoretical investigations and experimental photoluminescent analyses were conducted. The results suggest that the observed photoluminescent changes found in complexes and perovskite in the presence of VOCs are attributed to resonance between the density of states of the complex and the target, rather than a direct reactivity between them.
Finally, the functionalization on glass substrates of advanced photoluminescent materials demonstrated the formation of an Optical Platform with potential for Biomedical Compound Sensing. Moreover, there us the possibility of further enhancement of efficiency by incorporating ligands with energy levels resonant with biomarkers.