PÔSTER - RESUMO - SENSORES E BIOSSENSORES

FABRICATION AND CHARACTERIZATION OF HUMIDITY SENSORS BASED ON NON-FULLERENE ORGANIC SEMICONDUCTORS

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Precise monitoring of relative humidity (RH) is a critical requirement in advanced instrumentation, where atmospheric moisture levels directly influence the stability of food preservation, biochemical and industrial processes control. Unlike the detection of hazardous gaseous analytes, RH sensing is indispensable for maintaining the operational integrity of moisture-sensitive electronic devices and ensuring thermodynamic equilibrium in controlled environments. Consequently, there is an intensifying demand for sensing platforms characterized by high sensitivity, low-cost fabrication, and fast signal transduction[1]. In this context, conducting polymers (CPs) and organic semiconductors have emerged as promising materials due to their ability to interact with water molecules at room temperature, reversibly altering their electrical properties. Furthermore, the nature of these materials allows for solution-based processing, facilitating the large-scale production of flexible and wearable devices [2].

A significant innovation of this work lies in the strategic application of non-fullerene electron acceptors (NFAs) as gas sensing devices, which are beyond the traditional application area. While these materials have revolutionized organic solar cell efficiency, their electron affinity opens new avenues for diverse electronic architectures. In this study, thin-film devices based on non-fullerene organic semiconductors were fabricated for application as humidity sensors. The sensor architecture was explored through different deposition methodologies, aiming to optimize the active layer morphology and the electrode interface. We compared the techniques of Langmuir-Schaefer (LS), which offers nanometric molecular control; drop-casting, for its simplicity and technical feasibility; and the use of decorated nanofibers, aiming to increase the surface area to optimize the adsorption and desorption kinetics of water molecules. The devices were characterized through direct current (DC) electrical measurements, evaluating critical parameters such as relative response, stability, reversibility, and response time. Regardless of the fabrication technique, a substantial enhancement in electrical current was observed upon exposure to water vapor, coupled with excellent reversibility. Specifically, the devices exhibited over 90% reversibility; however, the film fabricated by LS displayed the lowest coefficient of variation (CoV), at approximately 15%, between cycles, a value considered acceptable for gas sensing applications. These distinct CoV levels among the fabrication techniques (LS, decorated nanofibers, and drop-casting) arise from the different morphologies formed, as the structural organization of the active layer directly dictates the reproducibility of the sensing response. These results demonstrate the potential of non-fullerene semiconductors for a new generation of high-performance environmental sensors.

References:

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Acknowledgments:

The authors are grateful for the financial support from the São Paulo Research Foundation, FAPESP (Grant No. 2024/22327-6), and the National Council for Scientific and Technological Development (CNPq, INEO). The authors also thank the National Nanotechnology Laboratory (LNNano/CNPEM, project LMF 2023090) for providing the Interdigitated Electrodes (IDEs).

Palavras-chave: thin films; non-fullerene acceptors; humidity sensor.