PÔSTER - RESUMO - DISPOSITIVOS ELETRÔNICOS, ELETROQUÍMICOS, SUPERCAPACITORES E BATERIAS

DEVELOPMENT AND CHARACTERIZATION OF SEMICONDUCTOR OXIDE NANOPARTICLE INKS FOR USE AS THE ACTIVE LAYER IN THIN-FILM TRANSISTORS

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Semiconductor metal oxides, such as zinc oxide (ZnO), exhibit characteristics that make them highly promising materials for application as active layers in electronic devices, especially thin-film transistors (TFTs), due to their ease of synthesis and processing, as well as their excellent electrical properties [1]. However, conventional thin-film deposition techniques, such as pulsed laser deposition (PLD) and radio-frequency (RF) sputtering, require specific deposition conditions, including high vacuum and the use of specialized gases, making them sophisticated and thus more complex. In contrast, solution-based approaches, such as spin-coating and spray pyrolysis, require high processing temperatures (>350 °C), making them incompatible with flexible substrates and less aligned with sustainability strategies. In this context, this work proposes the

development of inks based on zinc oxide nanoparticles (ZnO-NPs) applied as the active layer in thin-film transistors printed on flexible paper substrates. The ZnO-NPs were synthesized via hydrothermal, coprecipitation, and Pechini methods to understand and control the effects of these processes on the nanoparticles physicochemical, structural, and morphological properties. The TFT structure employed paper as the substrate, on which source and drain electrodes were formed by laser-induced carbonization, generating conductive carbon tracks. The ZnO-NPs, together with the binder carboxymethylcellulose (CMC), were used to produce water-based inks, which were deposited by screen printing to form the semiconductor layer. An ionic gel was used as the dielectric, and a metallic contact was employed as the gate electrode. The TFT performance was analysed by the characterization of its electrical properties, such as transfers (IDS-VGS) and outputs (IDS-VDS) curves, to obtain the mobility (μ), Ion/Ioff ratio, threshold voltage (VTH), and subthreshold swing (SS) parameters. The nanoparticles, printed layers, and fabricated transistors were characterized for their physicochemical, structural, and morphological properties using X-ray diffraction (XRD), scanning electron microscopy (SEM), UV–Vis reflectance spectroscopy, and Raman spectroscopy. The transistors fabricated with nanoparticles synthesized by different methods exhibited variations in their electrical parameters, demonstrating the influence of the synthesis route on device performance and the feasibility of producing sustainable, low-cost TFTs on paper substrates.

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References:

[1] Vieira, D. H.; Carlos, E.; Ozório, M. S.; Morais, M.; Fortunato, E.; Alves, N.; Martins, R. Ecofriendly Printed Wood-Based Honey-Gated Transistors for Artificial Synapse Emulation. Advanced Intelligent Systems, vol. 7, (2024).

Palavras-chave: nanoparticles; semiconductor inks; thin film transistors.