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

INTERFACE ENGINEERING OF ZNO THIN FILMS

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Developing advanced and efficient devices across various fields depends on a deep understanding of device architecture, material selection, and interfacial properties. Analyzing energy level alignment at interfaces in thin-film devices provides critical insights, including semiconductor electron/hole injection barriers, work function changes with film thickness, and interface charge density. These parameters are crucial for achieving an optimized device design. The integration of Atomic Force Microscopy (AFM) and Kelvin Probe Force Microscopy (KPFM) facilitates nanoscale characterization, establishing a direct correlation between electrostatic potential and film thickness [1].

This study focused on ZnO, a sustainable and transparent n-type semiconductor that absorbs UV light as the active material. Gold (Au), chromium (Cr*), and titanium (Ti*) were used as electrodes. We evaluated the surface potential of ZnO films (10-100 nm) deposited on these electrodes. The

results show that ZnO surface potential on Au stabilizes for films thicker than 20 nm, indicating bulk behavior. In contrast, thicker films are required on Cr* and Ti* electrodes. Based on these findings, vertical junction devices with 25 and 105 nm ZnO films were fabricated. The self-rolled nanomembrane architecture [1] was used, featuring a bottom Au contact and a thin ZnO film connected to the Au nanomembrane electrode, ensuring smooth, deposition-defect-free contacts. Current-voltage measurements at varying temperatures were performed. Charge transport in ZnO thin films is governed by film thickness, temperature, and electric field intensity. The 25 nm films exhibit Ohmic conduction, thicker films (105 nm) transition to the Space Charge Limited Current (SCLC) regime at fields exceeding 33.4 kV/cm (T = 300K). The replacement of the Au bottom electrode with Cr* introduces rectifying behavior and triggers a Trap-Filled Limited Current (TFLC) regime between 32.4 kV/cm and 105.4 kV/cm, followed by a reversion to SCLC at higher field strengths.

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References:

[1] C. V. S. Batista, L. Merces, C. A. R. Costa, D. H. S. De Camargo, C. C. B. Bufon, Adv. Funct. Mater, 32, 2108478 (2021).

Palavras-chave: interface; surface potential; atomic force microscopy; kelvin probe force microscopy; electronic device; nanomembrane.