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

EDMR ON A CHIP: HIGH-SENSITIVITY SPIN-DEPENDENT TRANSPORT ANALYSIS FOR NEXT-GENERATION SEMICONDUCTORS

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Semiconducting metal oxides (SMOs) and organic semiconductors have emerged as leading candidates due to their remarkable electronic and optical properties, compatibility with sustainable technologies, and potential for low-cost manufacturing [1]. Despite these advantages, their performance and stability remain constrained by atomic-scale paramagnetic defects and their dynamic interactions with environmental factors such as oxygen and water [2]. These mechanisms are not yet fully understood, creating a critical knowledge gap that limits the optimization of next-generation sensors and electronic devices [2]. To address this challenge, this research introduces Electrically Detected Magnetic Resonance (EDMR) on a Chip (EDMRoC) as a cutting-edge characterization technique [3]. Conventional Electron Paramagnetic Resonance (EPR) has long been used to identify defects in semiconductors, but its sensitivity is insufficient for thin films, and its geometry restricts in-operando analysis. EDMR, by contrast, detects changes in electrical transport directly linked to spin-dependent recombination processes, offering sensitivity several orders of magnitude higher than EPR. EDMRoC advances this approach by integrating microwave sources and detectors into micro-coils on a silicon chip, enabling frequency sweeps under static magnetic fields. This compact design minimizes noise from magnetic-field modulation, enabling real-time defect monitoring in operational devices. Using lock-in amplifiers with phase-sensitive detection, EDMRoC can measure extremely small signals, filtering out unwanted noise and isolating resonance-induced current variations. The methodology combines spin-resonance physics with electrical transport analysis. In EPR, unpaired electron spins absorb microwave radiation at resonance, and defects are identified through their characteristic Landé g-factor, which serves as a fingerprint of the local electronic environment. EDMR builds on this principle by monitoring current variations rather than absorption, so that when spins flip under resonance, the recombination rates of charge carriers change, producing measurable electrical signals. EDMRoC miniaturizes this setup, enabling in-operando analysis of thin-film devices with unprecedented sensitivity. By correlating spin transitions with dynamic current responses, the technique reveals how atomic-scale defects and adsorbed molecules such as oxygen and water modulate electronic transport. We aim to apply the developed EDMR-on-chip setup to characterize thin-film transistors (TFTs) based on SMOs and semiconducting polymers, thereby validating the technique. At the moment, we have developed all the needed electronics and magnetic field setup, as well as the needed calibration steps, which will be presented, and the challenges and experimental limitations will be discussed.

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Palavras-chave: electron paramagnetic resonance; electrically detected magnetic resonance on a chip; paramagnetic defects; semiconducting metal oxides; organic semiconductors.