Electrical, Optical, and Structural Characterization of Molybdenum Trioxide (MoO3) Nano Rods Particles

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Molybdenum trioxide (MoO_3) is a promising material for semiconductor devices due to its unique electrical and optical properties [1], making it suitable for memristive and charge-trapping applications in non-volatile memory and neuromorphic computing [2]. This study focuses on the deposition of MoO_3 films via spin coating, characterizing their electrical, optical, and structural properties, and integrating them into a charge-trapping device [3]. MoO_3 crystals were dissolved in isopropyl alcohol (IPA) at concentrations of 1g/L, 5g/L, and 10g/L, with the solution sonicated using a sonicator bath for 90 minutes, to ensure uniform dispersion and homogeneity. The deposition was conducted by spin coating speeds between 1200-2000 rpm, on silicon substrates of size 1.5x1.5 cm^2 and a solution volume of 10uL per layer. Structural and morphological analysis using SEM, and AFM revealed clustering in higher concentration solutions, which was mitigated by centrifuging at 5000 rpm for 30 minutes. Depositing the centrifuged solution exhibited a mean thickness value of 20nm, which represents a 2D layer of MoO3 [4]. Optical and electrical characterization confirmed a distinct absorption edge at 350 nm, a direct bandgap of approximately 3.2 eV for the deposited samples, and 3.6eV for the MoO_3 solution [5]. A high carrier mobility was also recorded averaging 1.8×10^3 $cm^2/V \cdot s$. MoO_3 was also integrated into charge-trapping devices with Aluminum Oxide (Al_2O_3) layers sandwiching the MoO_3 layer on a highly doped silicon base, demonstrating promising I-V characteristics [6]. These findings showcase MoO_3's potential for future semiconductor applications, with further optimization planned to enhance material deposition and device performance.

References

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Figures

Figure 1: Microscope Image of Orthorhombic Crystals structures of MoO_3 (α-MoO_3)

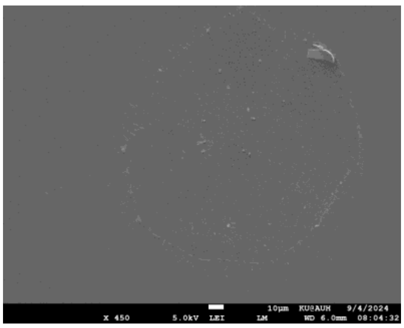

Figure 2: SEM image of Centrifuged MoO_3 deposited on silicon

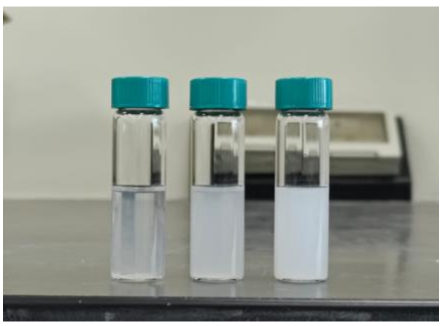

Figure 3: MoO_3 solution concentrations of 1g/L, 5g/L, and 10g/L (left to right)