



ELETRODEPOSITED Cu₂O NANOSTRUCTURED THIN FILMS: A COMPREHENSIVE ANALYSIS OF THE SYNTHESIS OPTICAL AND MICROSTRUCTURAL PROPERTIES

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Cu₂O is a promising multifunctional material that exhibits a wide range of applications. Due, especially, to the diversity of its physicochemical properties, which can be altered depending on the method of obtaining¹. In this study, we comprehensively analyze the optical and microstructural properties of Cu₂O thin films electrodeposited on SnO₂:F (FTO) substrates. The films were synthesized in the galvanostatic mode at different pH values (9 and 12) and temperatures (40, 45, 50, 55, 60, and 65°C) and characterized by X-ray diffraction (XRD), Raman spectroscopy, photoluminescence (PL), and electrochemical measurements (Figure 1)². The microstructural and optical characterizations confirm that the obtained films show deposit uniformity, reproducibility, chemical stability, constitutional purity (only the Pn3m Cu₂O phase), and crystallinity². Furthermore, films with different microstructures and optical properties were successfully obtained by adjusting the pH (9 and 12) and temperature (40, 45, 50, 55, 60, and 65°C) during the deposition process. The microstructural analyses indicate that the Cu₂O thin films deposited exhibit [111] orientation (at lower temperatures and pH 9) or [100] orientation (at higher temperatures and pH 9), and [111] orientation at pH 12. The optical and electrochemical analyses indicate that the Cu₂O thin films prepared at pH 9 exhibit higher strain and more defects (specifically, V_{Cu}) than those prepared at pH 12. Finally, given the relatively high charge carrier density of the synthesized films, it can be concluded that they are very promising for several applications, contributing to the development of advanced materials and devices based on Cu₂O, such as sensors and photocathodes.

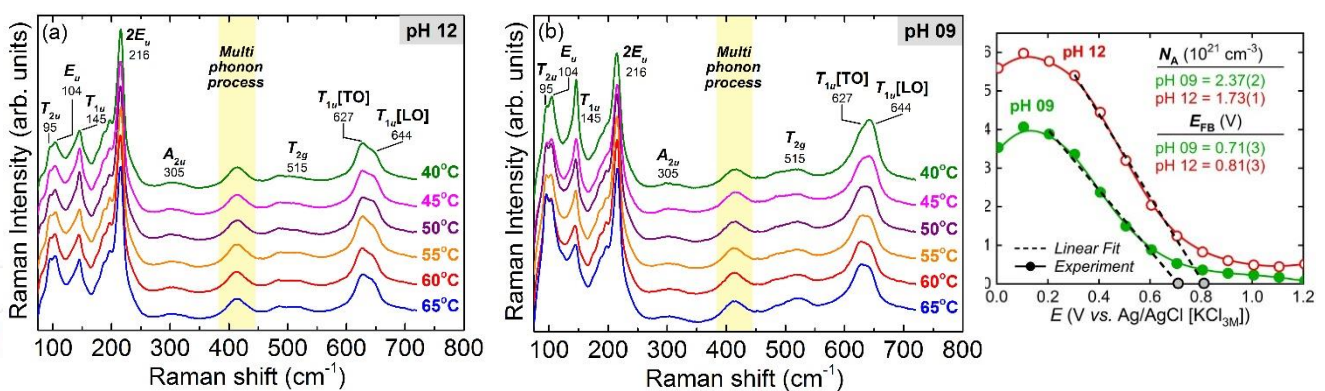


Figure 1. Raman spectrum of Cu₂O thin films electrodeposited at (a) pH 12 and (b) 9 in different bath temperatures, and (c) Mott-Schottky (MS) plots of the Cu₂O thin films electrodeposited at pH 9 and pH 12 at the temperature of 65 °C. The obtained parameters N_A (carrier density) and E_{FB} (flat band potential) after a linear fit of the MS plot are also presented.

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[1] BRANDT, I.S., *et al.*; Journal of Solid State Electrochemistry. 21 (2017) 1999–2020.

[2] BATISTA, C. G., *et al.*, Surfaces and Interfaces, 42, 2023, 103397