THICKNESS-DEPENDENT PROPERTIES OF $ZnIn_2S_4$ THIN FILMS DEPOSITED BY CBD METHOD

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Zinc indium sulfide ($ZnIn_2S_4$) is a ternary metal sulfide semiconductor that has attracted significant attention due to its suitable band gap, good chemical stability, and potential applications in optoelectronics, photocatalysts, and energy-related devices. Among various synthesis techniques, the chemical bath deposition (CBD) method stands out as a simple, cost-effective, and low-temperature process that enables uniform thin film growth over large areas and allows precise control of deposition parameters [1-2].

In this study, $ZnIn_2S_4$ thin films were deposited on FTO glass via chemical bath deposition (CBD). After establishing an optimal precursor recipe, the deposition time was systematically varied to determine the relationship between growth duration, film thickness, and structural properties. Specifically, deposition intervals of 1 h 45 min, 2 h 30 min, 3 h 30 min, and 4 h 15 min were investigated.

The results indicate that increasing the CBD duration leads to the formation of a thicker sulfide film. Structural analysis revealed that despite these changes in thickness, the $ZnIn_2S_4$ phase remains stable and consistent. However, a stable film failed to form when the deposition time was extended to 4 h 15 min. This behavior is likely attributed to excessive film thickness, which results in poor adhesion and subsequent delamination from the substrate. Based on these observations, the critical adhesion limit for these films occurs between the 3 h 30 min and 4 h 15 min marks.

These findings demonstrate that while deposition time is a crucial tool for controlling film thickness, it also defines the mechanical stability limits of $ZnIn_2S_4$ thin films.

[1] G. Zhang et al., “A mini-review on ZnIn2S4-Based photocatalysts for energy and environmental application,” Green Energy & Environment, vol. 7, no. 2, pp. 176–204, Dec. 2020, doi: 10.1016/j.gee.2020.12.015.

[2] X. Xin et al., “Large electronegativity differences between adjacent atomic sites activate and stabilize ZnIn2S4 for efficient photocatalytic overall water splitting,” Nature Communications, vol. 15, no. 1, p. 337, Jan. 2024, doi: 10.1038/s41467-024-44725-1.