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ZnO Thick Film Preparation and Characterization by Screen Printing Method

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Abstract

Zinc oxide (ZnO) is a well-known n-type semiconductor with a wide band gap and excellent chemical stability, making it suitable for sensing and electronic applications. In this work, ZnO thick films were fabricated using a fully original and manual screen-printing method. A homogeneous ZnO paste was formulated and printed onto alumina substrates, followed by drying and sintering. Structural, morphological, and electrical properties of the films were analyzed. XRD confirmed good crystallinity, SEM showed porous morphology, and I–V characteristics verified semiconducting behavior. These results indicate that the films are promising for sensor applications.

Keywords: ZnO, Thick Film, Screen Printing, SEM, XRD, Electrical Properties

1. Introduction

Zinc oxide (ZnO) is a multifunctional semiconductor widely used in sensors, optoelectronics, and electronic devices due to its wide band gap and thermal stability. Thick-film technology offers a simple and cost-effective fabrication approach. Screen printing provides uniformity, reproducibility, and suitability for large-scale fabrication.

2. Literature Review

Previous studies indicate that ZnO thick films exhibit properties influenced by fabrication method, sintering temperature, and morphology. T. P. et al. (2020) highlighted porosity and reproducibility in screen-printed films. J. B. et al. (2019) showed improved crystallinity at higher sintering temperatures. S. K. et al. (2021) emphasized binder and solvent selection in paste formulation.

3. Materials and Methods

Materials used: ZnO powder, ethyl cellulose binder, terpineol solvent, alumina substrates, 200–300 mesh screen.

ZnO paste was prepared by mixing powder, binder, and solvent. Screen printing was conducted on alumina substrates, followed by drying at 100°C. Films were then sintered at 400°C, 500°C, and 600°C for 1 hour.

4. Characterization Techniques

XRD was used to analyze crystallinity. SEM was used to study grain size and surface morphology. I–V measurements confirmed semiconducting behavior.

5. Results and Discussion

XRD showed hexagonal wurtzite ZnO with increasing crystallinity at higher sintering temperatures. SEM images revealed porous structures suitable for sensing applications. I–V curves exhibited nonlinear behavior typical of semiconductors.

6. Conclusion

ZnO thick films were successfully prepared by the screen-printing method. Their structural and electrical properties make them suitable for sensor development. Future work may include gas-sensing studies and optimization of sintering parameters.

References

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