

Rapid Microwave-Assisted Hydrothermal Growth of ZTO Nanowires through Systematic Parameter Optimization

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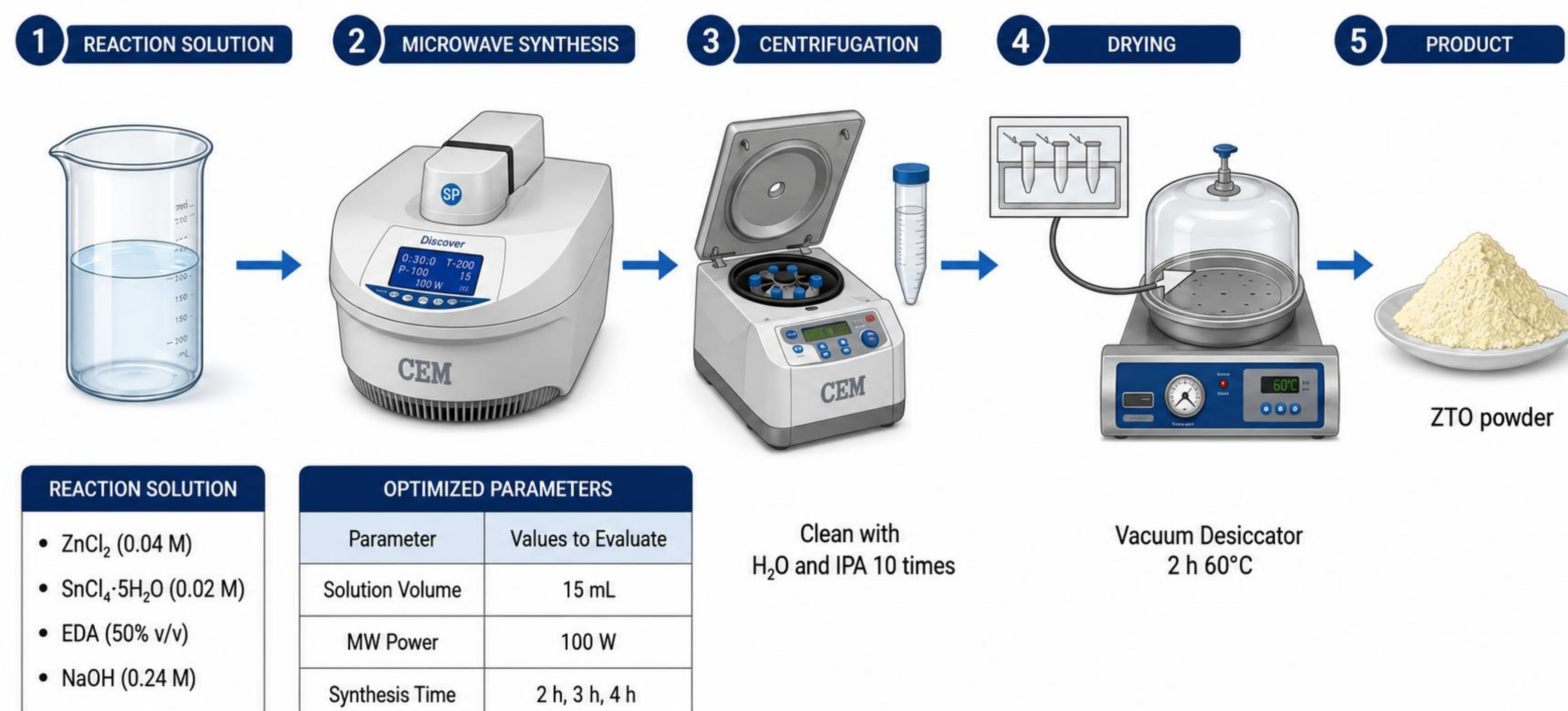
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INTRODUCTION & AIM

Zinc-tin oxide (ZTO) is a ternary metal oxide that offers promising properties for applications in electronics, energy harvesting and sensing devices due to its high electron mobility, chemical stability and tunable optical properties [1]. Among the different synthesis techniques, microwave-assisted hydrothermal synthesis has emerged as an efficient approach for producing nanostructured materials due to its fast and homogeneous heating [2]. However, the morphology and crystalline phases obtained are strongly influenced by the synthesis parameters employed [3]. In this work, the influence of solution volume, microwave power and synthesis time on the formation of ZTO nanowires was systematically investigated. A solution volume of 15 mL, a microwave power of 100 W, and synthesis times ranging from 2 to 4 h were evaluated to identify optimal synthesis conditions. The resulting nanostructures were characterized using scanning electron microscopy (SEM), X-ray diffraction (XRD) and Fourier transform infrared spectroscopy (FTIR) to assess morphology, crystalline structure and chemical bonding.

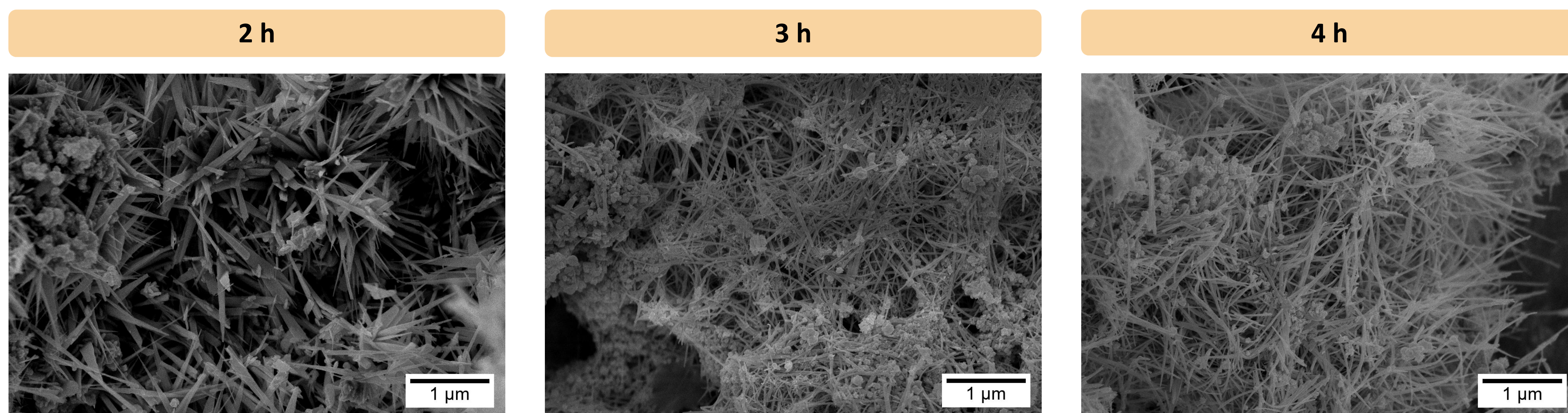
METHOD



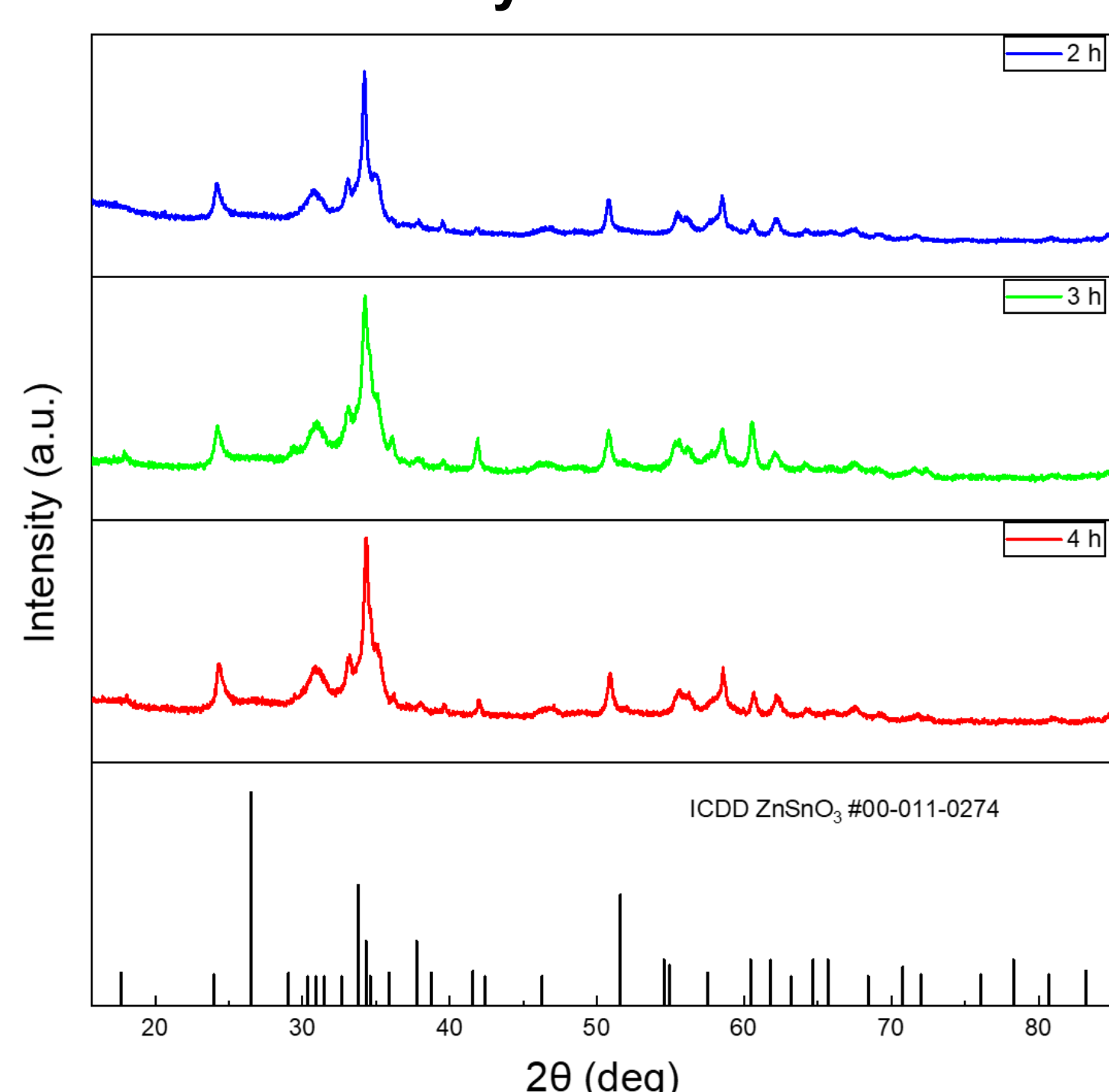
Hydrothermal synthesis using microwave allows a rapid and homogeneous heating and growth of ZTO nanostructures.

RESULTS & DISCUSSION

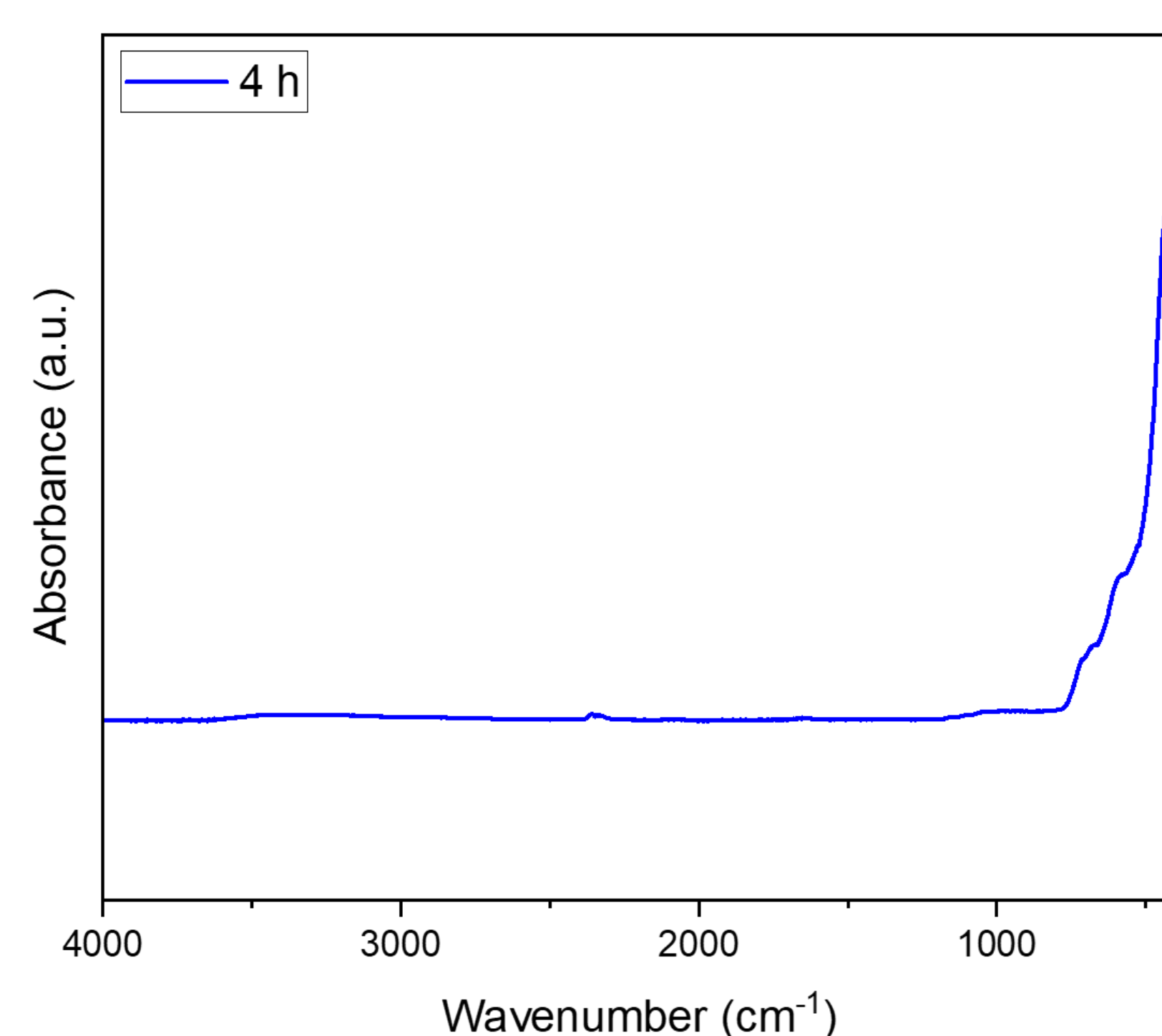
Scanning Electron Microscopy



X-Ray Diffraction



FTIR



→ XRD proved the presence of the ZnSnO₃ phase

→ FTIR proved that no -OH groups were present for a synthesis time of 4 h

Best synthesis time to obtain ZnSnO₃ nanowires: 4 h

Average length:
872 nm

Average thickness:
35 nm

Quantity:
50 mg

CONCLUSIONS

All tested synthesis conditions led to the formation of ZTO nanowire-like structures, with lengths ranging from ~700 to 900 nm. However, significant variations in nanowire density and homogeneity were observed, indicating a strong dependence on synthesis time. SEM analysis showed that longer synthesis times promote nanowire elongation, with the optimal condition (4 h) yielding long and dense ZnSnO₃ nanowires. XRD confirmed the crystalline nature and phase stability of ZnSnO₃ across all samples, while FTIR analysis revealed the absence of -OH groups for the 4 h synthesis. Overall, microwave-assisted synthesis enabled the production of high-quality ZnSnO₃ nanowires in only 4 h, achieving morphological and crystallinity quality comparable to conventional hydrothermal methods while reducing the synthesis time by approximately 20 h.

REFERENCES

- [1] Rovisco, A. et al., Discover Nano 2025, 20, 229.
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- [3] Rovisco, A. et al., Nanomaterials 2019, 9, 1002.
- [4] Rovisco, A. et al., ACS Appl. Nano Mater. 2018, 1, 3986–3997.

ACKNOWLEDGEMENTS

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