

The Effect of Calcination Duration to the Energy Bandgap of Biosynthesized SnO₂ Nanoparticles Assisted by Soybean Extract

Muhammad Ali Imran Mazuki^a, Zuraida Khusaimi^{a*}

Structured Abstract

Background: Nanotechnology has emerged as a vital tool in combating worldwide crises like epidemics and global warming. However, standard physical and chemical techniques of synthesizing nanoparticles are characterized by their inefficiency and possible threats to the environment. Biochemistry use plants, bacteria, fungus, yeast, and algae to create metal nanoparticles. This study utilized soybean extract to assist the formation of SnO₂ nanostructures. The purpose of this study is to investigate the effect of calcination duration to the energy bandgap of biosynthesized SnO₂ nanoparticles assisted by soybean extract.

Methods: Soybean was boiled to obtain its extract solution. The soybean extract was diluted in water, combined with SnCl₄.5H₂O solution and left to stir. Centrifuge procedure was used to extract the jelly-like material, and then was dried for 12 hours. The resulting yellow solid was thoroughly ground in a mortar and pestle before being thermally calcined at 700 °C for three different calcination times: 90, 150, and 180 minutes. The synthesized SnO₂ nanoparticles were then characterized using FTIR, XRD, FESEM, EDX, and UV-Vis DIR.

Results: FTIR spectrum has recorded for the prepared SnO₂ to confirm the presence of various functional and vibrational groups of SnO₂. XRD studies confirmed the tetragonal phase of the formed SnO₂ nanoparticles with average crystallite size in the range of 7.38–7.97 nm. XRD studies revealed that 90 minutes are the optimal calcination duration for the synthesis. FESEM images specified the SnO₂ nanoparticles with 90 minutes of calcination were agglomerated spherical with the size of 18.51 ± 2.67 nm. The band gap of synthesized SnO₂ nanoparticles with 90 minutes of calcination is 3.25 eV and the band gap of SnO₂ nanoparticles is found to be increasing with increasing calcination duration.

Conclusion: In conclusion, the findings of this study indicated that soybean extract has successfully assisted the biosynthesis of SnO₂ nanoparticles. UV-Vis DIR analysis found that the synthesized SnO₂ nanoparticles with 90 minutes of calcination had a band gap of 3.25 eV and that the band gap of SnO₂ nanoparticles increases with increasing calcination duration.

Keywords: Soybean, Tin Oxide Nanoparticles, Band Gap, Green Synthesis, Thermal Calcination

*Correspondence: zurai142@uitm.edu.my

^a School of Chemistry & Environment, Faculty of Applied Sciences, Universiti Teknologi MARA, Shah Alam, Malaysia