



EFFECT OF pH AND PRECURSOR TYPE ON GREEN-SYNTHESISED ZINC OXIDE PARTICLES USING MANGO SEED EXTRACT

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Abstract

Zinc oxide (ZnO) possesses optical and antimicrobial characteristics relevant to functional material applications. Plant-assisted synthesis provides an alternative to conventional ZnO synthesis routes that may involve chemical-intensive and energy-demanding processing. In this study, mango (*Mangifera indica*) seed extract (MSE) was used as a plant-derived synthesis medium to investigate the effects of pH and precursor type on ZnO characteristics. Zinc acetate dihydrate (ZA) and zinc nitrate hexahydrate (ZN) were separately mixed with MSE, adjusted to pH 5, 7, 8, 10, 12 or 14, subjected to controlled thermal and agitation treatments and subsequently recovered as dried ZnO products. The synthesised products were characterised using dynamic light scattering (DLS), zeta-potential analysis, scanning electron microscopy–energy-dispersive X-ray spectroscopy (SEM–EDX), Fourier-transform infrared spectroscopy (FTIR), X-ray diffraction (XRD) and ultraviolet–visible (UV–Vis) spectroscopy. ZA at pH 12 exhibited the most negative measured zeta potential (–25 mV) and the smallest DLS-derived hydrodynamic size of approximately 649 nm. SEM–EDX showed that all samples contain Zn and O elements and revealed predominantly spherical-to-irregular particle features for ZA, whereas ZN at pH 12 produced distinctive flower-like bundles. XRD confirmed the characteristic hexagonal wurtzite ZnO phase, with Scherrer-derived apparent crystallite sizes of approximately 17–39 nm. The larger DLS-derived hydrodynamic sizes relative to the XRD-derived apparent crystallite sizes reflected the different physical characteristics measured by the two techniques. FTIR showed Zn–O-associated absorption within approximately 400–600 cm^{–1}, while UV–Vis analysis showed pronounced absorption within approximately 250–300 nm, with the highest measured absorbance within the ZA series observed at pH 8. Overall, pH and precursor chemistry produced property-dependent responses, and no single synthesis condition provided the most favourable response across all evaluated characteristics.