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Comparison of optical and luminescence properties of as prepared and annealed ZnO nanoparticles synthesized using sol-gel method.

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Abstract content
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ZnO nanoparticles were synthesized using sol-gel method. The influence of the annealing temperature on the structural, morphological and optical properties of ZnO nanoparticles is studied. The properties were investigated using X-ray diffraction (XRD), scanning electron microscopy (SEM), photoluminescence (PL), Uv-Vis spectroscopy and EDS. XRD analysis demonstrates that the crystallinity of ZnO is improved with annealing for all growth temperatures as indicated by narrower and more intensified diffraction intensities of the annealed ZnO compared to that of the as prepared particles. The average crystallite sizes of the ZnO particles increased from 29.9 nm to 33.3 nm with annealing for the selected growth temperatures indicating the tendency of large grain growth in the nanoparticles due to annealing. SEM micrographs showed that annealed ZnO nanoparticles aggregated and became larger in diameter compared to its as prepared counterparts. The EDS analyses, for as prepared and annealed samples indicate the purity of all the synthesized samples with no peaks other than Zn and O. Annealing at 600 oC quenches the blue defect level emission but enhances the excitonic peak emission. The photoluminescence peak intensity ratios of ultraviolet to that of visible emission (UvPL/ VisPL) are found to increase on annealing. The UvPL/ VisPL intensities ratio range between 0.9-2.4 for the as prepared samples and 5.0-7.1 for annealed samples. Quenching of visible emission on annealing is known to be responsible for this. The red shift in both the visible and UV emission with increasing particle size due to annealing closely follows the red shift in the band edge emission, indicating that the two complement each other. The average band gap is observed to decrease from 3.25 eV to 3.22 eV with the increase in crystallite sizes occasioned by annealing.

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Main supervisor (name and email)
and his / her institution

F. B. Dejene, dejenebf@qwa.ufs.ac.za, UNIVERSITY OF THE FREE STATE.

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Primary author: Mr UNGULA, Jatani (University of the Free State)

Co-author: Prof. DEJENE, Francis (University of the Free State)

Presenter: Mr UNGULA, Jatani (University of the Free State)

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