

Non-catalytically grown ZnO nanostructures: Structural, optical and field emission properties

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The structural, optical and field-emission properties of non-catalytically grown ZnO nanostructures, i.e. aligned single-crystalline ZnO nanorods and flower-shaped structures, have been examined in this paper. By extensive structural characterizations, it was confirmed that the as-grown ZnO nanostructures are single-crystalline with the wurtzite hexagonal phase and grown along the c-axis direction. Raman-scattering spectra show a strong and sharp optical-phonon E2 mode at 437 cm^{-1} from the as-grown ZnO nanostructures which confirm the wurtzite hexagonal phase for the as-grown nanostructures. The room-temperature PL spectra exhibited a strong ultraviolet emission confirming the good optical properties for the as-grown products. The field emission characterization of the as-grown aligned hexagonal nanorods shows that a turn-on field was $5.8\text{ V}/\mu\text{m}$ and the emission current density reached to $0.061\text{ mA}/\text{cm}^2$ at an applied electrical field of $9.0\text{ V}/\mu\text{m}$ and shows no saturation. The field enhancement factor ' β ' was estimated, from the F-N plot, to be about $\sim 2.081 \times 10^3$.