Growth mechanism and Optical and Field Emission Properties of Aligned ZnO nanorods and Flower-Shaped Nanostructures Grown by Thermal Evaporation

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Optical and field-emission properties of aligned ZnO nanorods and flower-shaped structures, grown onto aluminum and silicon substrates, by using non-catalytic thermal evaporation process, have been examined. The structural characterizations indicated that the as-grown 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}, in both the cases again confirming the wurtzite hexagonal phase for the as-grown nanostructures. The room-temperature PL spectra exhibited a strong ultraviolet emission, in both the cases, confirming the good optical properties for the as-grown products. The field emission properties of the as-grown aligned hexagonal nanorods shows that a turn-on field was 5.8 V/μm and the emission current density reached to 0.061 mA/cm^2 at an applied electrical field of 9.0 V/μm and shows no saturation. The field enhancement factor 'β' was estimated, from the F-N plot, to be about ~2.081×10^3.