

Formation of hexagonal coaxial-shaped ZnO nanocolumns on steel alloy by thermal evaporation: Growth mechanism, Structural and Optical properties

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Large-quantity synthesis of single crystalline with perfect hexagonal coaxial-shaped ZnO nanocolumns have been achieved, for the first time, on steel alloy substrate through the thermal evaporation of metallic zinc powder at low temperature of 490°C without the use of metal catalyst or additives. Detailed structural analyses confirm that the formed nanocolumns are exhibiting a wurtzite hexagonal phase and preferentially oriented in the c-axis direction. Presence of a sharp, strong and dominated optical-phonon Raman-active E₂ mode in the Raman spectrum demonstrate that the grown products are good in crystal quality. In low temperature (LT) PL, the exciton emission bound to neutral donor (DOX) and free exciton (FX) dominated the edge emission region while the donor-acceptor pair (DAP) and its replica dominated the lower energy regions. With increased temperature DOX decreased abruptly and was then suppressed. With further increase in temperature the PL spectra was dominated by DAP.