

Nano-scale texture evolution of ZnO nano-rods at initial growth stage grown by chemical vapor deposition

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Structural evolution of ZnO nano-rods (NRs) at initial growth stage is investigated using transmission electron microscopy (TEM), x-ray diffraction (XRD) and grazing incidence wide angle x-ray diffraction (GI-WAXS) methods. ZnO NRs were grown by a chemical vapour deposition (CVD) on c-plane sapphire substrate without any buffer layer. ZnO NRs were grown vertically along c-axis and have in-plane epitaxial relationship, ZnO [10-10] // α -Al₂O₃ [11-20] and ZnO[0001]// α -Al₂O₃ [0001]. However, complicated texturing was introduced at initial growth stages by the tilted and rotated domains. Briefly, there are distinctly two major types of domains, one is vertically aligned domains and the other is $\sim 36^\circ$ tilted domains. Besides, minor two types coexist, one is vertically aligned but 0 degree rotated domains along in-plane direction (ZnO [11-20] // α -Al₂O₃ [11-20]) and the other is $\sim 90^\circ$ tilted domains. These complicated domain structure retards vertically aligned NR growth and compete each other at initial growth stage. These crystal domains and texture of NRs was studied by both an azimuthal angle dependent GI-WAXS and TEM analysis in detail.