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Effects of growth time on structural and optical properties of ZnO nanorods on Ga-doped ZnO seed layer for dye-sensitized solar cells photoanode

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ZnO nanorods (ZRs) were synthesized on glass substrates coated with Ga-doped ZnO (GZO) seed layer by a two-step chemical bath deposition technique (CBD) in an equimolar (50 mM) aqueous solution of zinc nitrate hexahydrate and hexamethylenetetramine at 90 ℃. The GZO NPs seeding was done to lower the thermodynamic barrier by providing nucleation sites to improve the aspect ratios and optical properties and ensure uniformity of ZRs [1]. The effect of CBD growth times 30, 60, 90, 120, 180, 240 and 320 min on the morphology, luminescence and optical properties of ZRs were investigated. The XRD analysis revealed that the as-grown ZRs have a crystalline hexagonal wurtzite structure and was preferentially oriented along the c-axis. The highest intensity of the (002) peak was observed on the 120 min among the growth durations studied. The SEM micrographs showed that both the length and aspect ratio of the ZRs increased as the growth time increases up to 120 min, then reduced at higher growth times. The photoluminescence measurement spectra depict an enhanced intensity ratio of the UV to visible emissions for ZRs grown on GZO seed layer indicative of high optical quality. The UV-Vis analysis showed that the transmittance of the films was above 80 % and the band gap varied from 3.20 to 3.3 eV with the increase in growth time.The highly transparent film composed of well-aligned ZRs with perfect crystallization produced at the growth time of 120 min can be used as a possible photoanode component in dye-sensitized solar cell.

Reference:
[1] H. K. Lee, M. S. Kim, J. S. Yu, Nanotechnology 22, 445602, 2011.

Summary

ZnO nanorods (ZRs) were synthesized on glass substrates coated with Ga-doped ZnO seed layer by a two-step chemical bath deposition technique (CBD) in an equimolar (50 mM) aqueous solution of zinc nitrate hexahydrate and hexamethylenetetramine at 90 ℃.The effect of CBD growth times 30, 60, 90, 120, 180, 240 and 320 min on the morphology, luminescence and optical properties of ZRs were investigated.The highly transparent film composed of well-aligned ZRs with perfect crystallization produced at the growth time of 120 min can be used as a possible photoanode component in dye-sensitized solar cell.

Apply to be
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YES

Level for award
 (Hons, MSc,
   PhD, N/A)?

PhD

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

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Would you like to
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YES

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