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ZnO Nanorods/Nanoplates for Gratzel-Type Dye Solar Cells Applications: Growth Mechanism

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<p>Zinc oxide is a direct, wide bandgap semiconductor material with many promising properties for blue/UV optoelectronics, transparent electronics, spintronic devices and sensor applications. ZnO has been commonly used in its polycrystalline form in a wide range of applications such as sunscreens, catalysts, piezoelectric transducers, varistors, and as transparent conducting electrodes. ZnO has numerous attractive characteristics for electronics and optoelectronics devices especially in solar cells. It has direct bandgap energy of 3.37 eV, comparable to of TiO₂ which makes it transparent in visible light. The exciton binding energy is about 60 meV for ZnO. The room temperature electron Hall mobility in single crystal ZnO is of the order of 200 cm<sup>

2</sup> V⁻¹. Unlike TiO₂, ZnO can be grown easily in anisotropic shape, specifically in form of nanorods or nanotubes. This central geometry of nano-scaled ZnO, in addition to the high surface/volume ratio for the adsorption of light-harvesting molecules, would offer a larger free mean path for electronic charge transfer and minimizes the e-hole recombination in a ZnO nanorods/nanotubes based excitonic Gratzel dye solar photocells. Indeed, this tubular ZnO geometry would enhance the device efficiency through the direct electrical pathways provided by the nanorods/nanotubes, ensures the rapid collection of carriers generated throughout the device, in addition to an effective light trapping. This contribution reports the growth mechanism of the ZnO nanorods by the so called Vayssieres hydrothermal method. It is demonstrated for the first time that in a large pH range within the hydrothermal process, the growth mode of the ZnO nanorods is a pure Frank-van der Merwe driven process. More precisely, nano-platellets of ZnO are formed at the early growth stage growing towards nano-rods. From crystallographic view point, both the ZnO nano-plattelets and nanorods exhibit the standard hexagonal wurtzite crystal structure, with (002) main orientation and lattice parameters a= 3.25 Å and c= 5.12 Å. The room temperature luminescence and Raman investigations indicates that the defects are mainly O deficiency driven.

Level (Hons, MSc,
   PhD, other)?

PhD

Consider for a student
   award (Yes / No)?

Yes

Would you like to
 submit a short paper
 for the Conference
 Proceedings (Yes / No)?

Yes

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