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# Plasmalab Data

## ZnO Nanowire Growth

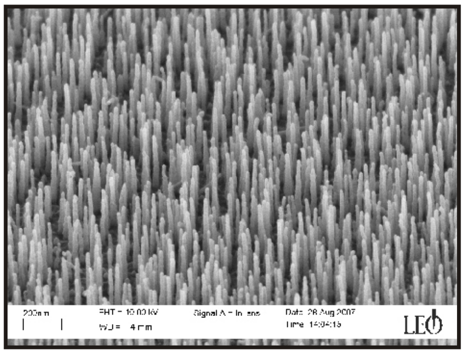
Zinc Oxide (ZnO) is a direct band-gap (E.g.=3.37eV) semiconductor with a large excitation binding energy (60meV), exhibiting near UV emission, transparent conductivity and piezoelectricity. Moreover, ZnO is biocompatible and can be used for biomedical applications without coating.

**Electronics** - ZnO nanowires and nanorods are good candidates for nanometre scale electronic applications, such as sensors or field emission transistors, because of their high sensitivity to the chemical environment. The sensing process is related to oxygen vacancies on the surface that influence the electronic properties of ZnO.

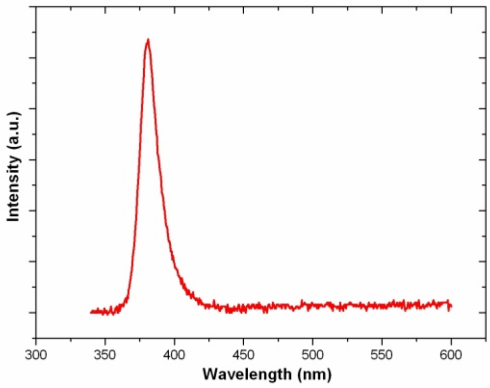
**Optoelectronics** - ZnO nanowires and nanorods are also potentially good candidates for nanometre scale photonic device applications, ultraviolet photo-detectors and light emitting devices. Both p-type ZnO nanowires and n-type ZnO nanowires can be produced as positively and negatively charged semiconducting materials, this forms good foundation to make light emitting diodes (LED), in which, as an electron meets a hole, it falls into a lower energy level and releases energy in the form of a photon of light.

**Photovoltaic** - ZnO nanowires and nanorods can be used for fabrication of solar cells that can be dye-sensitised using liquid or solid (hole conductor) electrolyte, because ZnO has a wide bandgap, high charge carrier mobility and can give a high surface area for efficient dye-sensitization and light harvesting.

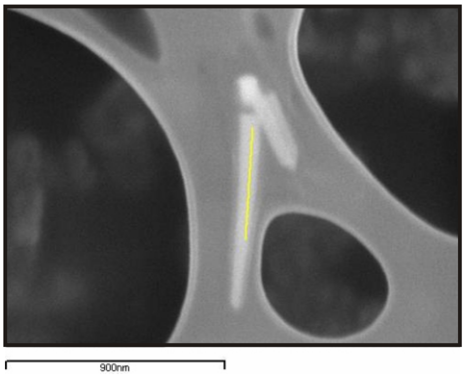
Vertically aligned ZnO nanorods on GaN-coated sapphire. The nanorods have an average length of 400 nm. The structures are catalysed by Au nanoparticles.



Courtesy of University of Cambridge Department of Engineering




Photoluminescence spectrum of ZnO nanorods grown on a-Si(100) substrate. The strong ultraviolet emission at around 381 nm is attributed to the near-band-edge emission of the wide bandgap ZnO. No broad defect-related green peak is observed indicating good crystallinity of the ZnO material.




The nanorods were detached from the growth substrate and dispersed onto a copper grid coated with a lacey carbon film.

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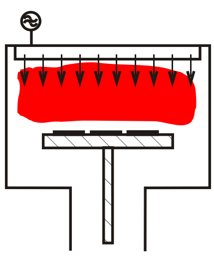
**Chemistry** - ZnO nanowires and nanorods can promote catalyst reactions with light as energy source, i.e. they can be used as photocatalysts.

**Biomedical** - The biocompatibility of ZnO nanowires and nanorods along with their electro-optical properties makes them suitable for active biomedical devices.

**Process benefits:**
Both liquid and gases precursors can be delivered controllably. Load-locked system offer shorter cycle times, as no cooling of the growth chamber is required to exchange samples.



Zinc precursor: $(C_2H_5)_2Zn$
Oxidising agent: $O_2$
Growth temperature: 450 – 625°C
Growth pressure: 300 – 1000 mTorr
Axial growth rate: ~ 7nm/min
Substrates used: Si(100), $Al_2O_3$ (11-20), GaN-coated $Al_2O_3$