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DOI: 10.1017/S1431927606061691

Microsc Microanal 12(Supp 2), 2006

Controlled Growth and Spectroscopy Study of Oxide Nanobelts

Zhong Lin (ZL) Wang * and Yong Ding

School of Material Science and Engineering, Georgia Institute of Technology
Atlanta GA 30332-0245, USA

* E-mail: zhong.wang@mse.gatech.edu

One-dimensional (1D) nanostructures (nanowires, nanobelts and nanorods) are the forefront nanomateirals for nanotechnology. Oxide nanostructures have been synthesized for a wide range of semiconducting oxides [1] that are potential building blocks for constructing numerous nanodevices. Using the technique demonstrated for measuring the mechanical properties of nanotubes [2,3], the mechanical and field emission properties of the oxide nanobelts have been characterized. Field effect transistors [4], ultra-sensitive nano-size gas sensors [5], nanoresonators and nanocantilevers [6] have been fabricated using nanobelts.

Structurally, the wurtzite-structured ZnO is non-central symmetric, and its property is anisotropic as well. It will be very interesting to investigate the electronic structure of ZnO nanostructures of different growth orientation. However, due to the diversity and lower purity of the samples prohibit the application of the well-established techniques, such as XPS, AES and UPS. Electron energy-loss spectroscopy (EELS) has a high spatial resolution and the possibility of investigating the electronic structure of a nanobelt and a nanotube. By combining the crystallographic and chemical information provided by transmission electron microscopy, EELS may have certain advantages for investigating nano scale electronic structure although its energy resolution is limited.

Electron energy-loss spectroscopy has been used to study the electronic structure of ZnO nanobelts [7]. The polar surface dominant $[01\bar{1}0]$ growth ZnO nanobelts show an extra surface plasmon peak at 13.0 eV compared to that from the non-polar surface dominant $[2\bar{1}\bar{1}0]$ growth nanobelts, which is suggested to be related to the polar surface. Crystallographic orientation dependence on the energy-loss near-edge structure of different types of nanobelts has been investigated. The observed fine structures at the O K-edge and Zinc L_3 edge agree with the calculated results.

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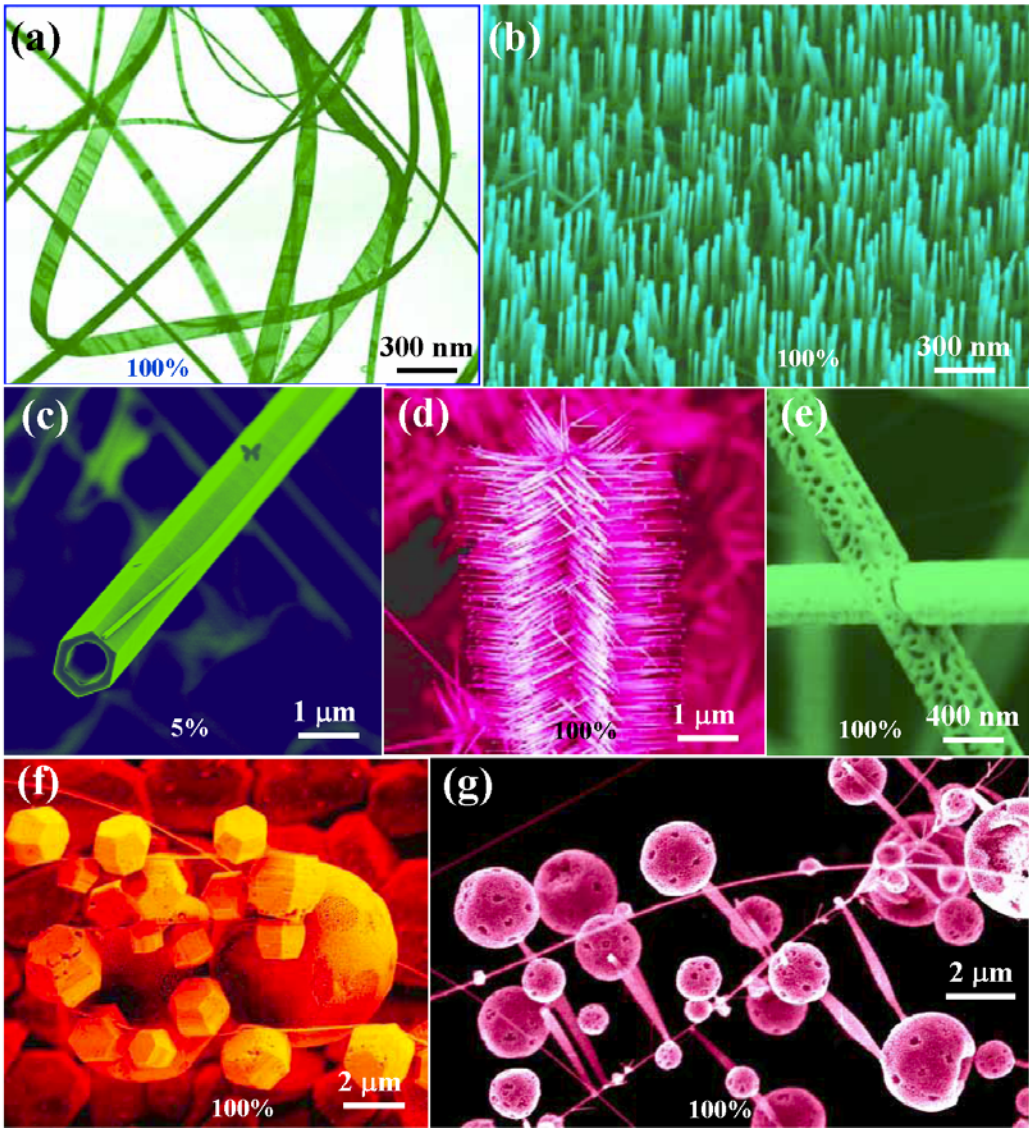
[9] for details see: http://www.nanoscience.gatech.edu/zlwang/



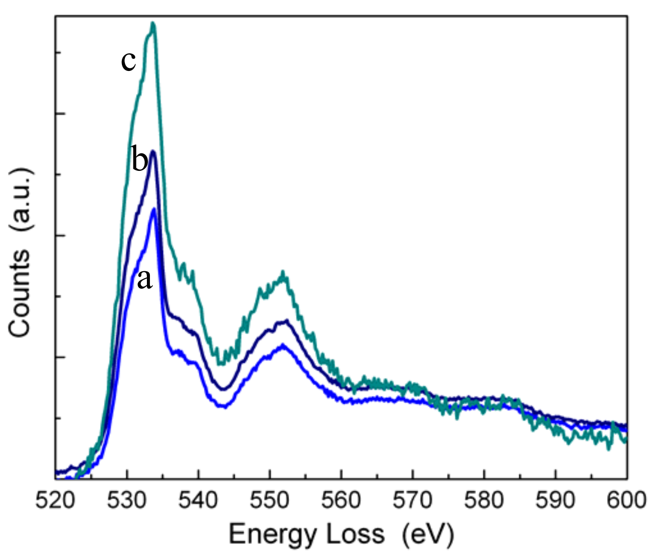


FIG. 1 Nanostructures of Zinc Oxide.

FIG. 2 Dependence of O-K edge on the angle of the incident electron beam with the c-axis for a polar nanobelt: a: ~0 °; b: ~10°; c: ~20 °.

https://doi.org/10.1017/S1431927606061691 Published online by Cambridge University Press