


Preparing Electronic Devices using Zinc Oxide		
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Research Topics

- Epitaxial growth of ZnO films
- Structural analysis of ZnO and ZnO-related materials
- Fabrication of electron devices using ZnO and ZnO-related materials

Research Seeds

Zinc oxide (ZnO) has attracted attention as a material for new electronic devices. It has the following useful features: (1) large exciton binding energy of 60 meV, (2) wide band-gap energy of 3.37 eV, (3) low resistivity of n-type conductivity, (4) strong piezoelectric property, and (5) eco-friendly. The research purpose of our group is fabrication of various electronic devices with useful properties of ZnO.

Main research contents of our research group are listed below:

i) epitaxial growth of ZnO films; ii) structural analysis of epitaxial ZnO-related films and bulk crystals; iii) fabrication of a palladium (Pd)/ZnO Schottky barrier diodes (SBDs); and iv) fabrication of ultraviolet (UV) sensors using ZnO films and bulk crystals.

For i) and ii) above, non-polar ZnO films (Fig. 1) are deposited on single-crystal Al_2O_3 , NdGaO_3 (NGO), and ZnO substrates [1, 2]. The crystal structure of non-polar ZnO films or ZnO bulk crystals is characterized using X-ray diffraction (XRD). In this research, high-quality non-polar ZnO films with a flat surface, good structural and photoluminescence properties were achieved on several single-crystal

substrates. In the research described in iii), Pd/ZnO SBDs are prepared and current-voltage (I-V) characteristics of SBDs are measured [3]. The I-V characteristics are improved remarkably by hydrogen peroxide (H_2O_2) treatment [4] for single-crystal ZnO substrates. In research of iv), UV sensors are fabricated using single-crystal ZnO bulks and polycrystalline; ZnO films are prepared using metal organic chemical vapor deposition (MOCVD). Characteristics of UV sensors are also improved by H_2O_2 treatment for ZnO films.

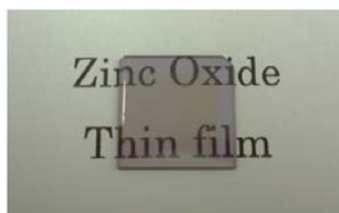


Fig. 1 ZnO film deposited on a single-crystal NGO substrate.

References

- [1] Y. Kashiwaba et al., *phys. stat. sol. A* **206**, 5, 944 (2009).
- [2] Y. Kashiwaba et al., *J. Electron. Mater.* **47**, 4345 (2018).
- [3] Y. Kashiwaba et al., *Appl. Surf. Sci.* **286**, 126 (2015).
- [4] Y. Kashiwaba et al., *J. Appl. Phys.* **113**, 113501 (2015).

Related Technology

- Structural analysis using the XRD system (bulk crystals and films)
- Preparation of metal films using vacuum evaporation apparatus
- Preparation of ZnO films using MOCVD