

# **ZnO nanostructures grown by non-catalytic thermal evaporation process: Optical and field emission properties**

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## **Abstract**

The field emission property, one of the most important applications, of nanostructured materials, possesses a great commercial interest in displays and other electronic devices. Among various oxide materials, the II-VI semiconductor ZnO recognize itself as one of the most exotic material in terms of properties, functionalities and morphologies. Therefore, by exploiting the excellent properties of ZnO, we fabricated the field emission devices (FEDs) by using various kinds of ZnO nanostructures such as aligned hexagonal nanorods, flower-shaped structures and microberets consist of hexagonal small nanorods. The nanostructures were synthesized by simple thermal evaporation process by using high purity metallic zinc powder and oxygen gas as source materials for zinc and oxygen, respectively in the temperature ranges of 450-650 °C. The detailed structural and optical observations revealed that the grown products are possessing single crystallinity with the wurtzite hexagonal phase and good optical properties. The performances of the field-emission devices based on the as-grown products have also been characterized. Vertically-aligned hexagonal-shaped ZnO nanorods show the turn-on electric field at about 5.8 V/ $\mu\text{m}$  with the emission current density of 0.061 mA/cm<sup>2</sup> which was achieved at the electrical field of 9.0 V/ $\mu\text{m}$ . The current density shows no saturation in the current while the field enhancement factor ' $\beta$ ' was estimated to be about  $\sim 2.081 \times 10^3$ . Flower-shaped nanostructures are exhibiting the turn-on field of 4.5 V/ $\mu\text{m}$  with the emission current density of 0.073 mA/cm<sup>2</sup> which was achieved at the electrical field of 7.1 V/ $\mu\text{m}$ . In this case also, the current density shows no saturation in the current and the field enhancement factor ' $\beta$ ' was estimated to be about  $\sim 2.9 \times 10^3$ .