SUMMARY OF Ph.D. DISSERTATION

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Title

Nanometric Morphological Control of Zinc Oxide Crystals with Wet Chemical Processing

Abstract

Wurtzite-type zinc oxide (ZnO), a wide band-gap semiconductor with excellent electronic and optical properties, has been utilized as varistors, surface acoustic wave filters, UV-cut films and pigments. Furthermore, this oxide crystal has great potential for advanced applications including light-emission diodes, biosensors, photocatalysts and solar cells. Control of the size and morphology in a nano-scaled range is essential to perform the excellent physical and physicochemical properties. In this study, a wide variety of strategies through wet processing routes were examined for fabrication of shape-controlled ZnO crystals. Eventually, the fundamental parameters for the control of the nano-scaled morphologies are clarified.

Chapter 1 summarizes the background and earlier works related to the fabrication of ZnO crystals. Then the objective of this thesis is mentioned.

Chapter 2 describes the control of the size and shape of ZnO fine particles prepared in a homogeneous solution system. Preparation of narrow size-distributed ZnO rods with a nanometric width and a submicrometric length was achieved by tuning the degree of supersaturation with using seed particles.

Chapter 3 shows shape-controlled fabrication of ZnO particles in organic gel matrix. Particular morphologies, such as star-like, ellipsoidal, and round shapes, were obtained through periodic precipitation in agar gel suppressing rapid mixing of precursor agents.

Chapter 4 mentions the effects of organic molecules for the morphology of ZnO crystals grown through heterogeneous nucleation on a substrate. Nanometric plates, thin rods and mosaic structures were obtained by the specific adsorption of the organic molecules.

Chapter 5 describes success in the epitaxial growth of ZnO crystals in aqueous systems. In particular, a novel morphology with in-plane alignment on the ZnO single-crystalline substrate is fabricated using a dye molecule having sulfonic groups.

Chapter 6 summarizes the results and discussion of this study. Finally, the essence for the morphological design of ZnO crystals and the prospects of wet processing routes are mentioned.