Effect of pH on Synthesis of Single Crystalline ZnO Tubes

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Introduction

A large quantity of submicrometer-sized hexagonal zinc oxide tubes was directly prepared by a novel simple method—bubble template method through introducing ammonia bubbles into $ZnCl_2$ solution. The pH of the solution played an important role on the formation of zinc oxide tubes. The effect of pH on the formation of ZnO tubes was investigated in this paper.

Experimental Methods

A conical flask with the aqueous solution (400ml) of Zinc Chloride (purity of 98% from Wako, Japan) was put into a water bath. The solution was stirred at the constant rate by the Teflon-coated magnetic stirring bar. The ammonia bubbles were introduced into the bottom of the solution through a micro-sized bubble maker (Tekeno, Japan). During the reaction, the pH and temperature of reaction solution were continuously measured by a pH meter (SG8, Mettler Toledo, Switzerland). When the pH arrived at the given constant, the ammonia bubbles were stopped immediately. The white precipitate was filtered, and then the products were dried and used for measurement.

Results and Discussion

Fig.1 showed XRD patterns of samples prepared at different pH. It was found that the composition of synthesized samples was strongly dependent on the pH of solution. When pH reached 8, single crystalline ZnO was synthesized.

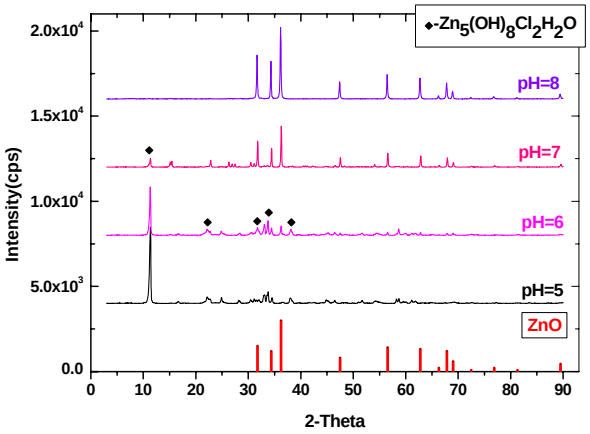

Fig. 1, XRD patterns of prepared samples

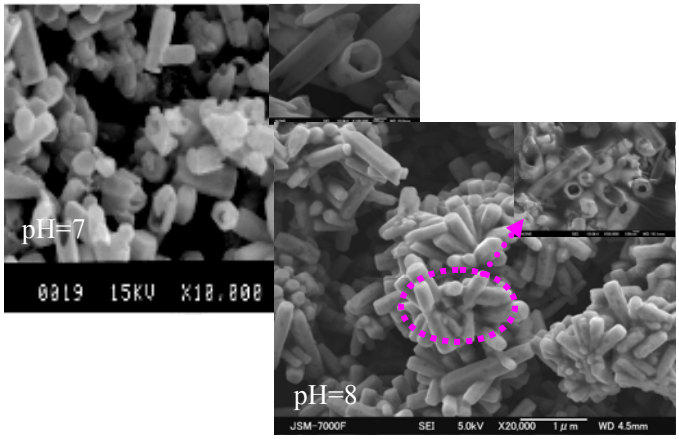

Fig.2 SEM images of prepared samples

Fig.2 showed SEM images of samples prepared at different pH. When pH was about 7, the products included rode-like particles and irregular particles. Some tubes with opening ends were also observed, as shown in the inset of pH 7. When pH reached 8, only rode-like particles were formed. The cut surface of samples revealed that all these rode had hollow structure inside. These particles were called ZnO tubes with average length of 1μm~2μm, diameter of 300nm~500nm and wall thickness of 20nm~50nm.

Conclusions

A new method to synthesize single crystalline ZnO tubes was proposed in our group. The effect solution pH on the synthesis of ZnO tubes were discussed in this paper.

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Biographical Sketch

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Ms. Lin received her bachelor's degree in 2002 and received her MD degree in material physics and chemistry at School of Microelectronics and Solid -State Electronics, University of Electronic Science and Technology of China (UESTC) in 2005. Currently she is studying in Ceramics Research Laboratory, Nagoya Institute of Technology for her doctor's degree.

Her research during the doctor studying is focused on preparation and application of zinc oxide tubes by a novel and simple method—bubble template method.