ZnO Nanorods Crystal Growth on the Seed-layer Prepared by RF Sputtering

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Introduction: ZnO nano-structures are interesting material due to its excellent electronic and catalytic properties, such as a wide direct band gap (3.37 eV), high exciton binding energy (60 meV) and surface interaction between atmospheric molecules at room temperature. Various methods are available for synthesis of ZnO nano-structures, including chemical vapor deposition, electrochemical deposition, sputtering deposition and pulse laser deposition. Hydrothermal processes are comparatively simple with relatively lower temperature, large area growth with convenient control of growth parameters [1]. Thus, it is a capable method for growing ZnO nanorods crystal. In this study, we focused on the preparation of the seed-layer by using RF sputtering in order to obtain aligned nano-rods crystal film of ZnO employing by hydrothermal technology [2].

Experiment: The growth of ZnO nano-structure is followed in the two-step processes: firstly, a seed layer is deposited on a quartz glass substrate by RF sputtering technique. Secondly, ZnO nanorods crystals are grown by hydrothermal processes. ZnO seed layers were deposited on the quartz glass substrate by using RF sputtering. The sputtering was carried out using ZnO target at the substrate temperature of 250°C in argon atmosphere (5 $x10^{-2}$Pascal) and RF power was 130W. After deposited seeding layer, the substrate was transferred to the autoclave for ZnO nanorods crystal growth. Zinc nitrate hexahydrate ($Zn(NO_3)_2$) and hexamethylenetetramine ($C_6H_{12}N_4$) 0.02 M were dissolved in a DI water 50 ml and transferred to a Teflon-lined autoclave. The substrate was put in the autoclave vessel, which was maintained at 120°C for 2 h. After the growth, the ZnO film was washed by DI water and annealed in hot air at 150 ºC for 1 h.

Results and Discussion: The crystallographic morphology and structure of ZnO are strongly influenced with many parameters, such as seed layer cystal nature, solvent concentration and reaction system. In this report, we investigate the effect of seed layer preparation on the formation of ZnO nanorods crystal. **Fig. 1** shows XRD pattern and FE-SEM images of (a) ZnO sputtered seed-layer and (b) grown ZnO nanorods. The XRD pattern shows that the nanorod crystal are aligned only on the seed layer crystal with the main orientation of (002) following small sub-orientation (100). After hydrothermal crystal growth, (002) orientation is increased with after grown ZnO nanorods.

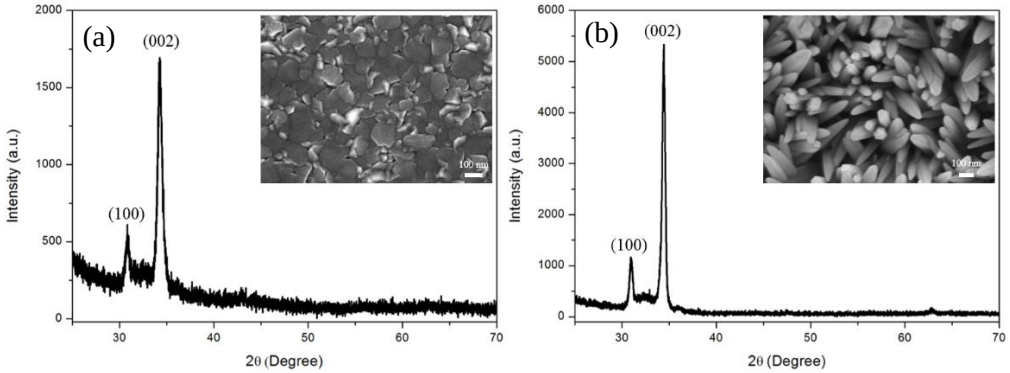

Fig. 1 XRD pattern and FE-SEM images of (a) ZnO sputtered seed-layer and (b) grown ZnO nanorods

Moreover, we found an aspect on the selective crystal growth of nanorods crystal. If we use a patterned seed layer, crystals of nanorods are grown up only on the seed layer. **Fig.2** shows a patterned nanorods obtained by hydrothermal crystal growth.

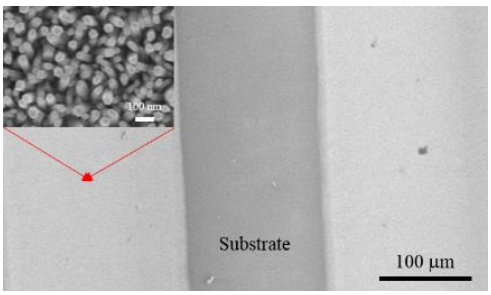

Fig. 2 FE-SEM image of selective growth crystal ZnO nanorods with patterned seed layer

<**Reference**>

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