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Effect of Substrate Temperature and Post-Annealing on Structural and Electrical Properties of ZnO Thin Films for Gas Sensor Applications

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ZnO is a promising material since it could be applied to many fields such as solar cells, laser diodes, thin films transistors and gas sensors. ZnO has a wide and direct band gap for about 3.37 eV at room temperature and a high exciton binding energy of 60 meV. In particular, ZnO features high sensitivity to toxic and combustible gas such as CO, NOX, so on. The development of gas sensors to monitor the toxic and combustible gases is imperative due to the concerns for enviromental pollution and the safety requirements for the industry.

In this study, we investigated the effect of substrate temperature and post-annealing on structural and electrical properties of ZnO thin films. ZnO thin films were deposited by pulsed laser deposition (PLD) at various temperatures at from room temperature to 600°C. After that, post-annealing were performed at 600°C. To inspect the structural properties of the deposited ZnO thin films, X-ray diffraction (XRD) was carried out. For gas sensors, the morphology of the films is dominant factor since it is deeply related with the film surface area. Therefore, the atomic force microscopy (AFM) and field emission scanning electron microscopy (FE-SEM) were used to observe the surface of the ZnO thin films. Furthermore, we analyzed the electrical properties by using a Hall measurement system.

Keywords: ZnO, Thin film, Pulsed laser deposition (PLD), Gas sensor applications