

Activation like behavior on the temperature dependence of the carrier density in In_2O_3 -ZnO films

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We focus on the effect of annealing effect in high vacuum to the transport properties for In_2O_3 -ZnO films. We prepared indium zinc oxide films by the DC-magnetron sputtering method using an In_2O_3 -ZnO target (89.3 wt % In_2O_3 and 10.7 wt % ZnO). The annealing temperature in our experiments is from 373 to 773 K. From the XRD analysis, we find that all as deposited films are amorphous, and films are crystallized by annealing at a temperature above 773 K over 2 hours. The temperature dependence of resistivity $\rho(T)$ of all amorphous films shows metallic behavior. On the other hand, $\rho(T)$ of poly In_2O_3 -ZnO films shows semi-conducting behavior. We carry out a detailed analysis of the temperature dependence of Hall effect. The activation energy E_d has been obtained from the slope of the carrier concentration N_e vs the inverse temperature plot at high temperatures. We found that the E_d takes values between 0.43 and 0.19 meV. Meanwhile, temperature dependence of N_e for poly- In_2O_3 -ZnO films did not show activation-like behavior. This behavior is thought to be causally related to impurity conduction band.