Green ZnO Phosphor by Oxidation of Metallic Zinc in Air - Y.G. Wang (Nanyang Technological University), X.H. Zhang (Institute of Materials Research and Engineering), S.P. Lau, and H.W. Lee (Nanyang Technological University)

ZnO is a low voltage phosphor that can be used in flat panel display. For nominally undoped ZnO two luminescent bands in the light range of green and orange are often observed. The actually mechanism behind them are still unclear by now, the green band is attributed to oxygen vacancy and copper impurity. In this presentation, the oxidizing behaviors of metallic zinc are studied using SEM, XRD, and photoluminescence spectrum. The oxidation is carried out in open air in a tube furnace by varying annealing temperature and annealing time. The band edge UV emission shows four different types of behavior. Low temperature (350-500^{0}C), its intensity increases with time and the samples annealed at 390^{0}C for 16hours show the strongest UV emission. The second range (550-750^{0}C), the UV emission and deep level emission are all weak, increase slowly with temperature. The third is above 800^{0}C, for short time annealing, films show strong UV emission, and however after a maximum its intensity decreases quickly with time. The four is above 1000^{0}C, the UV and deep level emission show little time dependence. The deep level emission could be divided into two emission bands, one is green emission around 2.3eV, and the other orange band at 1.9eV. The latter one is obvious only in low temperature annealed sample. For low annealing temperature (<750^{0}C) the intensity of deep level emission is very low and grows very slowly with time. At high temperature, the intensity increases quickly with annealing time and reaches saturation after about 5 hours. However, at 1000^{0}C annealing it saturates in short time (20mins) and its value is very small compared to that annealed at 900^{0}C. According to these experimental data, it can be seen that to preparation green ZnO phosphor, the optimum temperature is around 900^{0}C for time around 8hours. The variations of the PL with temperature and time can be explained by the dynamic balance between oxidation process, defect formation process and ZnO sublimation process. And our experiment proves that intrinsic defect, maybe oxygen vacancy, is responsible for the often observed green band in ZnO.