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Application Study on Organic Light Emitting Diodes and Piezoelectric Devices Using Zinc Oxide Films

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Transparent conductive, undoped and aluminum-doped ZnO (AZO) thin films were prepared on the glass substrates at room temperature by RF magnetron sputtering. Highly oriented AZO films in the [002] direction were obtained with specifically designed ZnO targets. Systematic study on dependence of deposition parameters on structural, optical and electrical properties of the as-grown AZO films was mainly investigated in this work. The AZO film prepared at R.T. with 4 wt.% AZO target under target-to-substrate distance (D_{ts}) of 45 mm has not only a high transmittance of 85% at the visible region but has also a resistivity of 9.8×10^{-2} Ωcm. In addition the resistivity of AZO films increases with increasing T_{sub}. We investigated that all of tendency was changed before and after 4 wt.% doping. However, the resistivity of AZO film is higher than ITO film using organic electro-luminescence(EL) device, we tried to bring low the barrier between the devices as deposited AZO films on ITO substrates. We fabricated the organic EL structure consisted of Al as cathode, Al_2O_3 as electro transport layer, Alq_3 as emission layer, TPD as hole transport layer and AZO(150 nm) as anode. The result of this experiment was not good compared with the case of using ITO. Then the quantum efficiency was to be 0.4%.

Zinc oxide is an excellent piezoelectric material with simple structure and composition. ZnO film is applied to the piezoelectric devices because it has high resistivity and highly c-axis textured structure. Structural and electrical properties of ZnO films are influenced on deposition conditions. Lithium doped ZnO (LZO) films were deposited by RF magnetron sputtering method using Li-doped ZnO ceramic target of various ratio (0 to10 wt.% LiCl dopant). LZO films revealed high resistivity of above 107 Ωcm with smooth surface when they were deposited under room temperature with 4 wt.% LiCl doped ZnO target. But, their c-axis orientation was worse than one of pure ZnO film. We have also studied on structural, optical and electrical properties of the ZnO films by XRD, AFM, SEM, XPS, and 4-point-probe analyses. We concluded that amount of Li dopant was increasing, the c-axis orientation decreased, even though the electrical resistivity increased.