Properties of Indium Tin Oxide Thin Films Deposited on Flexible Plastic Substrate at Low Temperatures

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ABSTRACT

Transparent and conductive indium tin oxide (ITO) thin films were deposited on glass substrates Corning 1737F and Polyethersulfone (PES) flexible plastic substrates by DC magnetron sputtering. The crystalline substrates and optical-electric characteristics were investigated to achieve the optimum room-temperature growth conditions. The crystalline orientation and the surface morphology were characterized by the X-ray diffraction (XRD) and the atomic force microscopy (AFM), respectively. The ITO/substrates interfaces were observed by the scanning electron microscopy (SEM). In addition, the resistivity, the Hall effect, and the optical transmittance were measured to characterize the photo-electric properties of as grown films. It is found that the ITO films are epitaxially grown with the orientations [222], [400], and [440] perpendicular to the film plane. Moreover, a decreased resistivity of thin film with an increase of X-ray (222) diffraction intensity. The obtained optimum growth conditions for the room-temperature deposition are: DC power = 300 W, deposition pressure = 2 mtorr, and the gas of Ar : O2 = 100 : 1. With the optimum conditions, the resistivity of 6.61X10-4 Ω cm, carrier concentration of 2.31X1020 cm-3, and the transmittance of 88% for films grown on glass substrates are obtained. For the films grown on PES substrates, the lowest resistivity 6.42X10-3 Ω cm with carrier concentration of 1.13X1019 cm-3 and the transmittance of 85% can be achieved. Comparing these results with those reported by other workers, it is concluded that an improved photo-electric properties of ITO films can be obtained by using the DC magnetron sputtering technique at low temperatures.

Keywords : DC magnetron sputtering、 PES、ITO

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