SiOx buffer layer of GZO film on PET substrate

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Effect of oxygen pressure of SiO_x buffer layer on the electrical properties of GZO film deposited on PET substrate

The present work was made to investigate the effect of oxygen pressure of SiO_x layer on the electrical properties of Ga-doped ZnO (GZO) films deposited on poly-ethylene telephthalate (PET) substrate by utilizing the pulsed-laser deposition at ambient temperature. For this purpose, the SiO_x buffer layers were deposited at various oxygen pressures ranging from 13.3 to 46.7 Pa. With increasing oxygen pressure during the deposition of SiO_x layer as a buffer, the electrical resistivity of GZO/SiO_x/PET films gradually decreased from 7.6 × 10^{-3} to 6.8 × 10^{-4} Ω·cm, due to the enhanced mobility of GZO films. It was mainly due to the grain size of GZO films related to the roughened surface of the SiO_x buffer layers. In addition, the average optical transmittance of GZO/SiO_x/PET films in a visible regime was estimated to be ~ 90% comparable to that of GZO deposited onto a glass substrate.

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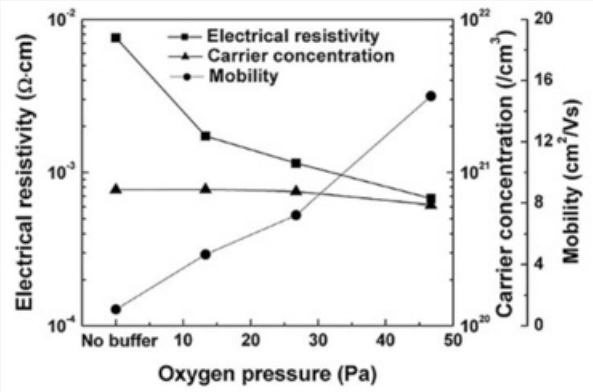

Fig. 4. Variation of the carrier concentration, Hall mobility, and resistivity as a function of the oxygen pressure of the SiO_x buffer layer for GZO films deposited at room temperature. All of the GZO films were grown by a PLD method at room temperature under an oxygen pressure of 4 Pa.

Fig.4 presents the variation of the electrical properties as a function of oxygen pressure of SiOx buffer. With the oxygen pressure increased, the electrical resistivity decreased from 7.6 x 10^{-3} to 6.8 x 10^{-4} Ω·cm and the mobility increased from 1 to 15 cm^2/Vs, whilst the carrier concentrations remained invariant to the oxygen pressure. The decrease in resistivity with increasing oxygen pressure led to the increase in the mobility. The mechanisms governing electron transport behavior were ionized impurity scattering, lattice vibration and grain boundary scattering, depending on temperature tested. For a GZO film at temperature ranging from 298 to 190 K, grain boundary was found to be a dominant micro structural variable inhibiting the mobility of charge carriers. Similarly, it was thought that the electrical conductivity of GZO/SiOx/PET was controlled by grain size associated with Hall mobility.

Keywords

Ga-doped ZnO;Polyethylene telephthalate;SiOx;Buffer;Electrical resistivity