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Interface effect of heat treatment on amorphous In-Ga-Zn-O thin film transistor as a function of oxygen flow rate

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Abstract

The effect of heat treatment on the electrical properties of an amorphous In-Ga-Zn-O (a-IGZO) film deposited by radio frequency (rf) magnetron sputtering at room temperature (RT) was investigated as a function of the oxygen flow rate. All of the films deposited with increasing O_2 concentration in the Ar and Ar+O_2 atmospheres exhibited insulating behavior in terms of their electrical properties, but their carrier concentration and resistivity were greatly affected after being annealed at 400 ℃ with either a vacuum furnace or RTA system.

Transparent amorphous oxide semiconductors (TAOSs) show promising potential as flexible electronic devices due to their capability of large area deposition and low temperature process [1-2]. Among these TAOSs, a-IGZO as a channel layer in TFTs exhibited large field effect mobilities (> 10 cm^2 V^{-1} s^{-1}) at a low temperature and even at room temperature (RT), which is better than those of a-Si:H, a pentacene single crystal and pentacene thin film. However, it is necessary to understand various defects such as the surface states, contact problem, and interface effect of reactive gases despite the excellent performance.

In this study, we investigated the reactive gas effect of an a-IGZO thin film as function of various gas flows on glass substrate by mean of a radio frequency (rf) magnetron sputtering with an $InGaZnO_4$ target and reported the electrical & optical properties of the a-IGZO films. In addition, we examined the interface effect of heat treatment on amorphous In-Ga-Zn-O TFTs as a function of oxygen flow rate by Transmittance Electron Microscope (TEM) and reported on defect state and effect of heat treatment of these TFTs in relation to the device performances.

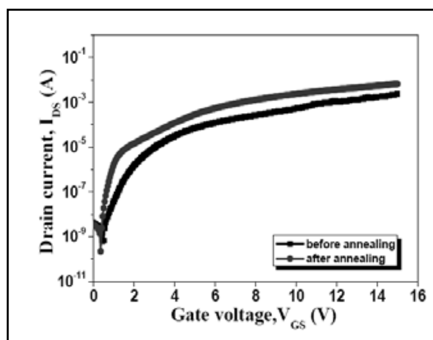

Figure 1: Transfer characteristic of TFT before and after annealing

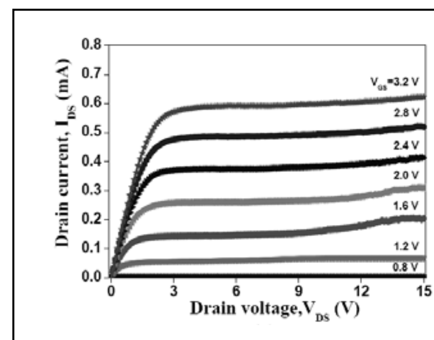

Figure 2: Output characteristic of TFT after annealing

References

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