PW-P012

Investigation of Effective Contact Resistance of ZTO-Based Thin Film Transistors

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Thin-film transistors (TFTs) based on oxide semiconductors have been regarded as promising alternatives for conventional amorphous and polycrystalline silicon TFTs. Oxide TFTs have several advantages, such as low temperature processing, transparency and high field-effect mobility. Lots of oxide semiconductors for example ZnO, SnO2, In2O3, InZnO, ZnSnO, and InGaZnO etc. have been researched. Particularly, zinc-tin oxide (ZTO) is suitable for channel layer of oxide TFTs having a high mobility that Sn in ZTO can improve the carrier transport by overlapping orbital. However, some issues related to the ZTO TFT electrical performance still remain to be resolved, such as obtaining good electrical contact between source/drain (S/D) electrodes and active channel layer. In this study, the bottom-gate type ZTO TFTs with staggered structure were prepared. Thin films of ZTO (40 nm thick) were deposited by DC magnetron sputtering and performed at room temperature in an Ar atmosphere with an oxygen partial pressure of 10%. After annealing the thin films of ZTO at 400^{o}C or an hour, Cu, Mo, ITO and Ti electrodes were used for the S/D electrodes. Cu, Mo, ITO and Ti (200 nm thick) were also deposited by DC magnetron sputtering at room temperature. The channel layer and S/D electrodes were defined using a lift-off process which resulted in a fixed width W of 100 μm and channel length L varied from 10 to 50 μ m. The TFT source/drain series resistance, the intrinsic mobility (μi), and intrinsic threshold voltage (Vi) were extracted by transmission line method (TLM) using a series of TFTs with different channel lengths. And the performances of ZTO TFTs were measured by using HP 4145B semiconductor analyzer. The results showed that the Cu S/D electrodes had a high intrinsic field effect mobility and a low effective contact resistance compared to other electrodes such as Mo, ITO and Ti.

Keywords: Contact resistance, ZTO TFT, AOS