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Transparent Thin Film Transistor using Al_2O_3/HfO_2 as Gate Insulator Layer

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In the last few years, thin film transistors (TFTs) have been studied in the field of using a various active layer materials. According to requirements of large area deposition and stability of device, transparent oxide semiconductors (TOSs) have paid attention to the new candidates for alternative channel materials of TFTs. Generally, amorphous Si(a-Si) has limitation such as low mobility(0.5~1) and failed operation according to shift of threshold voltage. To solve limitations, TOSs have been researched. TOS based TFTs with switching device of OLEDs have high electron mobility(~100 cm^2/VS), high on/off current ratio(10^7~10^8), and a low threshold voltage (1~2 V). Besides, it is possible to process in low temperature.

In this work, we investigated the electrical properties of transparent TFT with Al_2O_3/HfO_2 gate insulator layer. The bottom-gate TFT was fabricated with Al_2O_3/HfO_2 dielectric and ZnO channel layer grown by atomic layer deposition(ALD). The study indicated that the properties of double layer in gate insulator can be explained using C-V, I_d-V_d, I_d-V_g curves. This results can be used such as transparent electronic device.

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Improving Properties of Transparent TFT using changing properties of Channel Layers

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Recently, oxide semiconductor have been studied instead of a-Si and poly-Si materials for thin film transistors (TFTs). Si-based TFTs has low mobilities and high threshold voltage. Besides, Si-based TFTs has limitations of light sensitivity and opaqueness. ZnO-based TFTs were proposed as a way to fix these problems. ZnO as channel layer has advantages such as wide bandgap, transparency in the visible range, high mobility for higher switching speeds, optical properties, good performance and stability due to the lack of grain boundaries in the channel. Most TFTs have used SiO_2 and SiN_x as gate insulator. Therefore TFTs using SiO_2 or SiN_x has required high driving voltage. To solve the problem, high dielectric constant k (high-k) materials as gate insulator have been used instead of low k materials. In this work, we investigated the electrical properties of transparent TFT with Al_2O_3/HfO_2 with gate insulator layer. The bottom-gate TFT was fabricated with Al_2O_3, HfO_2 dielectric grown by atomic layer deposition(ALD) and ZnO channel layer grown by R.F. magnetron sputtering. The study showed that the properties of channel layer in accordance with changing of thickness can be explained using XRD, I_d-V_d, I_d-V_g graphs. ZnO-based TFTs will be applicable to transparent flexible electronic devices like wearable computers and bend paper displays.