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Process effects on morphology, electrical and optical properties of a-InGaZnO thin films by Magnetic Field Shielded Sputtering

이동혁, 김경덕, 홍문표*

고려대학교

The amorphous InGaZnO (a-IGZO) is widely accepted as a promising channel material for thin-film transistor (TFT) applications owing to their outstanding electrical properties [1, 2]. However, a-IGZO TFTs have still suffered from their bias instability with illumination [1-4]. Up to now, many researchers have studied the sub-gap density of states (DOS) as the root cause of instability. It is well known that defect states can influence on the performances and stabilities of a-IGZO TFTs. The defects states should be closely related with the deposition condition, including sputtering power, and pressure. Nevertheless, it has not been reported how these defects are created during conventional RF magnetron sputtering. In general, during conventional RF magnetron sputtering process, negative oxygen ions (NOIs) can be generated by electron attachment in oxygen atom near target surface and then accelerated up to few hundreds eV by a self-bias; at this time, the high energy bombardment of NOIs induce defects in oxide thin films. Recently, we have reported that the properties of IGZO thin films are strongly related with effects of NOIs which are generated during the sputtering process [5]. From our previous results, the electrical characteristics and the chemical bonding states of a-IGZO thin films were depended with the bombardment energy of NOIs. And also, we suggest that the deep sub-gap states in a-IGZO as well as thin film properties would be influenced by the bombardment of high energetic NOIs during the sputtering process.In this study, we will introduce our novel technology named as Magnetic Field Shielded Sputtering (MFSS) process to prevent the NOIs bombardment effects and present how much to be improved the properties of a-IGZO thin film by this new deposition method. We deposited a-IGZO thin films by MFSS on SiO2/p-Si and glass substrate at various process conditions, after which we investigated the morphology, optical and electrical properties of the a-IGZO thin films.

References

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