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Effect of Negative Oxygen Ions Accelerated by Self-bias on Amorphous InGaZnO Thin Film Transistors

김두현, 윤수복, 홍문표

고려대학교 디스플레이반도체·물리학과

Amorphous InGaZnO (α-IGZO) thin-film transistors (TFTs) are are very promising due to their potential use in thin film electronics and display drivers [1]. However, the stability of AOS-TFTs under the various stresses has been issued for the practical AOSs applications [2]. Up to now, many researchers have studied to understand the sub-gap density of states (DOS) as the root cause of instability [3]. Nomura et al. reported that these deep defects are located in the surface layer of the α-IGZO channel [4]. Also, Kim et al. reported that the interfacial traps can be affected by different RF-power during RF magnetron sputtering process [5]. It is well known that these trap states can influence on the performances and stabilities of α-IGZO TFTs. Nevertheless, it has not been reported how these defect states are created during conventional RF magnetron sputtering. In general, during conventional RF magnetron sputtering process, negative oxygen ions (NOI) can be generated by electron attachment in oxygen atom near target surface and accelerated up to few hundreds eV by self-bias of RF magnetron sputter; the high energy bombardment of NOIs generates bulk defects in oxide thin films [6-10] and can change the defect states of α-IGZO thin film. In this paper, we have confirmed that the NOIs accelerated by the self-bias were one of the dominant causes of instability in α-IGZO TFTs when the channel layer was deposited by conventional RF magnetron sputtering system. Finally, we will introduce our novel technology named as Magnetic Field Shielded Sputtering (MFSS) process [9-10] to eliminate the NOI bombardment effects and present how much to be improved the instability of α-IGZO TFTs by this new deposition method.

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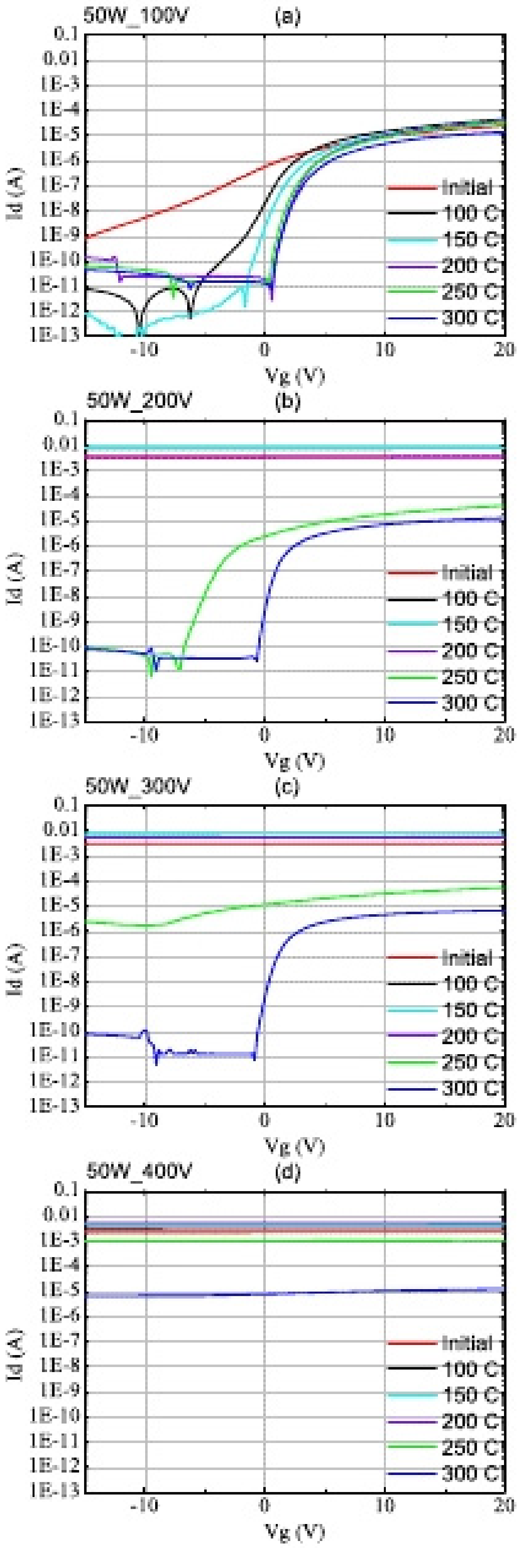

Figure. The transfer characteristics of a-IGZO TFTs with different self-bias in superimposed rf/dc magnetron sputtering as function of different post-anneal temperature: (a)100V, (b) 200V, (c) 300V, and (d) 400V.