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Effect of negative oxygen ion bombardment on the gate bias stability of InGaZnO

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InGaZnO (IGZO) thin-film transistors (TFTs) are very promising due to their potential use in high performance display backplane [1]. However, the stability of IGZO TFTs under the various stresses has been issued for the practical IGZO 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 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 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 IGZO thin film.

In this study, we have confirmed that the NOIs accelerated by the self-bias were one of the dominant causes of instability in 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 IGZO TFTs by this new deposition method.

References

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