IMPROVEMENT IN CARRIER MOBILITY OF METAL OXIDE THIN-FILM TRANSISTOR BY A MICROSTRUCTURE MODIFICATION

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Metal oxide thin-film transistors (TFTs) have been rapidly penetrating as an emerging backplane technology for the next generation high pixel density, large-size liquid crystal displays and organic light-emitting diodes panels because of their intriguing properties such as their high field-effect mobility, low subthreshold gate swing, good uniformity, low temperature processing capability, and transparency to visible light.[1-3] However, the typical field-effect mobility of IGZO TFTs in the practical production line is ~10 cm^2/Vs, which is still not enough to drive the high-end flat panel displays with the ultra-high-definition, large size (≥ 60 inch) and high frame rate (≥ 240 Hz). One of ways to improve the mobility of electron carriers in metal oxide semiconductor would involve the lattice ordering, which leads to the substantial reduction in the carrier scattering with the semiconductor. Approach that seeks to utilize the crystallization of metal oxide semiconductor has yet to be attempted despite the potential scientific and engineering implication. In this presentation, we explored the metal-induced crystallization of amorphous zinc thin oxide (a-ZTO) and indium gallium zinc oxide (a-IGZO) semiconductor at a low temperature. The fabricated crystalline ZTO TFTs exhibited a high field-effect mobility of 33.5 cm^2/Vs, subthreshold gate swing of 0.40 V/decade, and $I_{ON/OFF}$ ratio of $> 5 \times 10^7$. The method in this study is expected to be applied to any type of metal oxide semiconductor.

Acknowledgment
This study was supported by the National Research Foundation of Korea (NRF) grant funded the Korean government (NRF-2015R1A2A2A01003848) and the industrial strategic technology development program funded by MKE/KEIT (10051403).

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