저온 공정 온도에서 Al_2O_3 게이트 절연물질을 사용한 InGaZnO thin film transistors

우창호, 안철현, 김영이, 조형균*

* *School of Advanced Materials Science and Engineering, Sungkyunkwan University, Republic of Korea*
E-mail: asdfg1103@skku.edu

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Thin-film-transistors (TFTs) that can be deposited at low temperature have recently attracted lots of applications such as sensors, solar cell and displays, because of the great flexible electronics and transparent. Transparent and flexible transistors are being required that high mobility and large-area uniformity at low temperature [1]. But, unfortunately most of TFT structures are used to be SiO_2 as gate dielectric layer. The SiO_2 has disadvantaged that it is required to high driving voltage to achieve the same operating efficiency compared with other high-k materials and its thickness is thicker than high-k materials [2]. To solve this problem, we find lots of high-k materials as HfO_2, ZrO_2, SiN_X, TiO_2, Al_2O_3. Among the High-k materials, Al_2O_3 is one of the outstanding materials due to its properties are high dielectric constant (~ 9), relatively low leakage current, wide bandgap (8.7 eV) and good device stability. For the realization of flexible displays, all processes should be performed at very low temperatures, but low temperature Al_2O_3 grown by sputtering showed deteriorated electrical performance. Further decrease in growth temperature induces a high density of charge traps in the gate oxide/channel. This study investigated the effect of growth temperatures of ALD grown Al_2O_3 layers on the TFT device performance. The ALD deposition showed high conformal and defect-free dielectric layers at low temperature compared with other deposition equipments [2]. After ITO was wet-chemically etched with HCl : HNO_3 = 3:1, Al_2O_3 layer was deposited by ALD at various growth temperatures or lift-off process. Amorphous InGaZnO channel layers were deposited by rf magnetron sputtering at a working pressure of 3 mTorr and O_2/Ar (1/29 sccm). The electrodes were formed with electron-beam evaporated Ti (30 nm) and Au (70 nm) bilayer. The TFT devices were heat-treated in a furnace at 300 °C and nitrogen atmosphere for 1 hour by rapid thermal treatment .The electrical properties of the oxide TFTs were measured using semiconductor parameter analyzer (4145B), and LCR meter.

References

[1] J. B. Kim, C. F. Hernandez, W. J. Potscavage, Jr., X. H. Zhang, and B. Kippelen, Appl. Phys. Lett. 94 (2009) 142107

[2] S. Chang, Y. W. Song, S. Lee, S. Y. Lee, and B. K. Ju, Appl. Phys. Lett. 92 (2008) 192104

†교신저자) 조형균, e-mail: chohk@skku.edu, Tel: 031-290-7364
주소: 경기 수원시 장안구 천천동 성균관대학교