Atomic Layer Deposited Indium Zinc Oxide Thin Films and the Associated Device Performances

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Recently, amorphous oxide semiconductors as active layers have been already mass-produced in active matrix liquid crystal display (AMLCD) and active matrix organic light emitting diodes (AMOLED) due to reasaonable field effect mobility (>10cm2/v.s), amorpohus structure, and simply deposition process[1]. In terms of active channel layers, conventional sputtering techniques had been natural limitations for controlling multi-compositions and defect-generations on large-size backplanes. To solve those probelms such as oxygen defect-generation, non-uniform compositions, and unreliable device performances, a few reserachers have suggested vapor deposition methods like chemical vapor deposition (CVD) and atomicl layer deposition (ALD). In particular, ALD technique is well-known to be exact thickness control, composition, and less-defect generation due to self-limiting and complement reactions[2]. Unfortunately, there are a few reports to demonstrate oxide semiconductor TFTs based on ALD process due to limiting proper precurosrs for oxide semiconductors.

In this work, ALD Indium Zinc Oxide (IZO) thin films were depsoited by using both liquid In precursor and Zn prerusror. The ozone was used as an oxygen reactant. The IZO films was systemtaically investigated with various In/Zn contents (5:1. 3:1, 2:1, 1:1, 1:2, 1:3, 1:5) at 150°C, resulting in different electrical and physical properties. Moreover, the associated TFT exhibited , saturation mobility of 3.40 $cm^2 V^{-1} s^{-1}$ in the saturation region was obtained, with an subthreshold swing (SS) 0.45 V/decade, a thresholdgate voltage (Vth) of 1.77 V and an on/off ratio of 9.24×10^5, while the conducting layer (as-deposited) turned to be a semiconducting property at 500°C annealing. This presentation will be discussed physical/chemical/electronic properties related with IZO TFT performances.

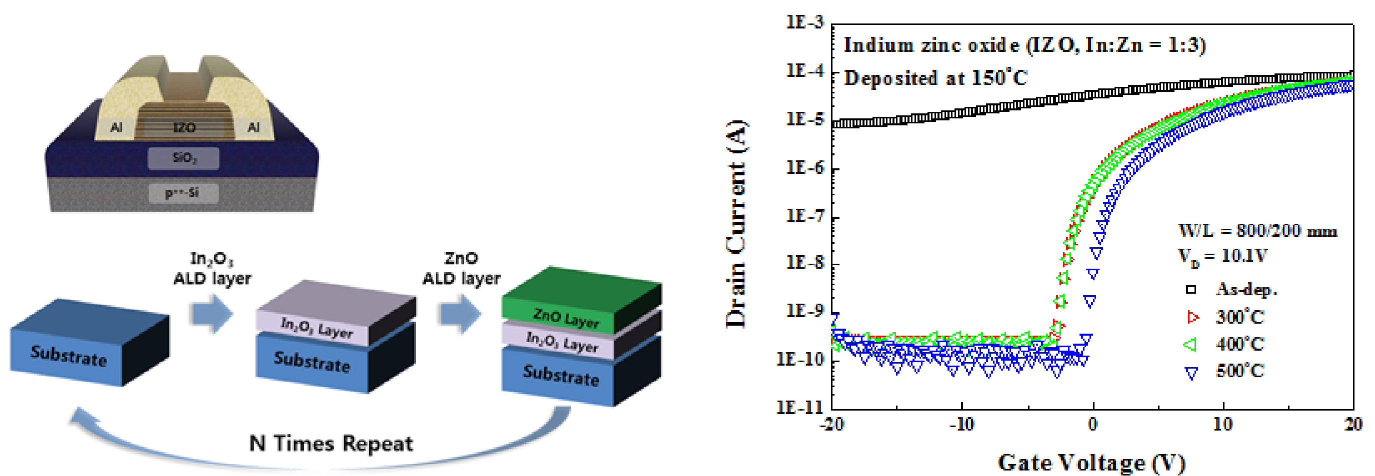

Fig. 1. . (left) TFT structure and brief ALD condition (right) representative transfer characteristics of IZO ALD TFTs as functions of annealing temperatures

Reference
[1] Joon Seok Park, Wan-Joo Maeng, Hyun-Suk Kim, Jin-Seong Park, Thin Solid Films, 520, 1679–1693 (2012)
[2] S.M.George, Chem. Rev. 110, 111 (2010)