

# INTRODUCTION ON ATOMIC LAYER DEPOSITION FOR HIGH-K DIELECTRIC & HIGH MOBILITY OXIDE SEMICONDUCTOR THIN FILM TRANSISTORS

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Amorphous oxide semiconductors have been widely studied for the potential use in flat panel displays such as active matrix liquid crystal display (LCD) and Organic light emitting diodes (OLEDs). Since reporting amorphous InGaZnO semiconductor thin film transistor (TFT) in 2003 & 2004, many multi-component oxide semiconductors have been intensively investigated and developed by reactive sputtering method. Very recently, the sputtered InGaZnO TFTs are already adopted in mass-production to fabricate AMOLED TVs. However, there remain several problems such as high mobility & stability issues. Also, virtual and argument reality (VR, AR) applications are rapidly emerging in display markets but the main issues are high resolution and low-voltage driving technologies.

Although there are considerable issues in oxide TFT applications, authors thought that high mobility oxide semiconductor and high-k gate insulator will be very important for the coming TFT devices. In this talk, those semiconductor and high-k dielectric will be discussed in terms of oxide TFT performances. All issued materials are deposited by plasma enhanced atomic layer deposition (PEALD), which is already adopted in Semiconductor industry. ALD is unique and reliable thin film deposition method below 50nm thickness due to very low process tact-time. In the first session, I will discuss ALD ITZO semiconductor thin film and the associated device performance. The ITZO ALD TFTs exhibited around 30cm<sup>2</sup>/V.sec of mobility and low hysteresis (~0.2V). The content of SnO<sub>2</sub> is a very important key factor to control mobility and reliability. In second session, ALD deposited ZrO<sub>2</sub> thin film as a gate insulator will be discussed. The ZrO<sub>2</sub> thin film is getting crystallized as the deposition temperature increased from 200°C to 300°C. The crystallinity may help to increase dielectric constant but loose the mobility of oxide TFT due to the columbic effect. It will be discussed how to optimize ALD oxide semiconductor and dielectric materials to get best performance. Although ALD process is too early to use in Display Application, but ALD technique will be very useful for the coming challengeable device applications.

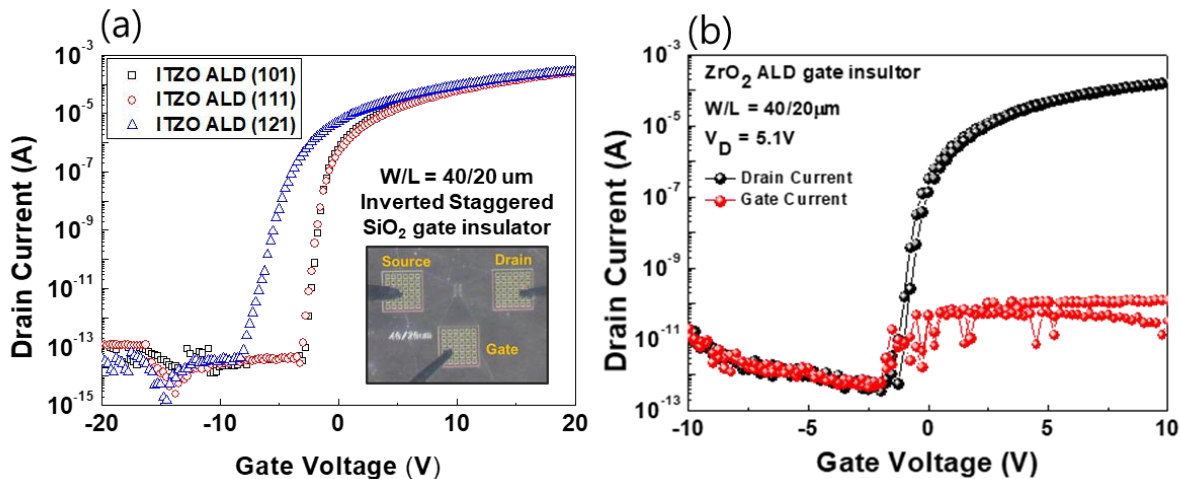


Figure 1 – (a) Representative Transfer curves of InSnZnO ALD oxide semiconductors with thermal SiO<sub>2</sub> gate insulators depending on ALD SnO<sub>2</sub> cycle. (b) Representative Transfer curve InSnZnO (sputtered) TFT with ALD ZrO<sub>2</sub> gate insulators.