High mobility thin film transistors: metal oxide vs. metal oxynitride semiconductors

Jin-Seong Park[1]
[1]**Division of Materials Science and Engineering, Hanyang University, Seoul 133-791, Korea**
Tel.:82-2-2220-0401, E-mail: jsparrkliime@hanyaang.ac.kr

Since amorphous oxide semiconductor (AOS) has been reported in 2004, 10 years have already passed in display research and development. AOS thin film transistors exhibited reasonable electrical performances (mobilty ~ $10 cm^2/V.s$, on/off ratio $>10^8$, and low off current (<10fA)). Finally, several efforts in AOS thin film transistors (TFTs) can be produced active matrix organic light emitting didoes televisions and low-power consumption liquid crystal display panels. Recently, display markets shift rapdily to develop ultra high definition (UHD, 8K × 4K) and flexible/wearable devices. Among several high-resolution issues, the mobility in the TFT is one of important problems to consider pixel areas and compensation circuits.

In this talk, I will disucss various AOS and novel Zinc oxynitirde semiconductors materials themselfves, in terms of physical, chemical, and electrical properties. Figure 1 exhibited the hall mobility-carrier concentration relationship among promising candidates for high mobility TFTs. This talk will present candidate mateiral properties and the associated device performances, inclduing amorpohous ITGO and ZnON. The native properties (bandgap, chemical stability, effective mass, and composition) between metal-oxide and metal-oxynitride may be significant keys to understand different device performances (mobility and stability). Thus, materials selection and process conditions for each semiconductor will be discussed to achieve high mobility TFTs.

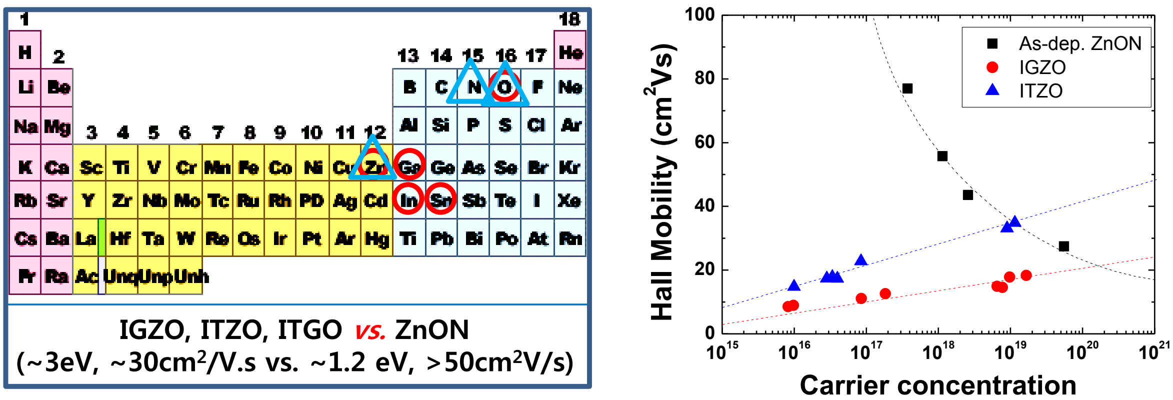

Fig. 1. (left) Periodic Table for metal oxide semiconductors (circle) and metal oxynitride (triangle) (right) The relationship between Hall mobility and Carrier concentration (Rectangle: As-deposited ZnON, Triangle: InSnZnO, Circle: InGaZnO)

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