PROGRESS OF P-CHANNEL OXIDE-TFT DEVELOPMENT AND HOW WE IMPROVE THE PERFORMANCES

Kenji Nomura, Department of Electrical and Computer Engineering, University of California, USA
kenomura@eng.ucsd.edu

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It is well known that n-channel oxide-TFTs, i.e. a-IGZO-TFT is a great success in TFT back-plane technology for the state-of-art AMFPDs because of their excellent device performances including high-mobility and low-off current characteristics and good mass-product liability compatible with large sized glass substrates. There are remaining issues such as the development of higher electron mobility and better stability channels and intense device and material developments still take place. Therefore, several high mobility n-channel oxide-TFT have been developed already. (Fig.1) On the other hand, the absence of practical device quality of p-type channel oxide-TFT still remains the largest issue in an oxide semiconductor and is recognized as the technological barrier that should be overcome for next-generation oxide device technology because many circuit applications such as CMOS require a counterpart of n-channel-TFTs. Since many oxides consist of localized VBM structures composed of oxygen-2p orbitals and are very sensitive to film quality, developing new p-type material with different VBM structures is required. So far, many efforts on p-type oxide material development have been devoted and several p-type oxide systems have been discovered. However, these most p-type oxides are not applicable to the TFT channel due to several issues such as uncontrollable high hole carrier density and high-density subgap defect density. Therefore, p-channel oxide material is very limited, and the well-known Tin monoxide (SnO) and cuprous oxide (Cu2O) are the only options for p-channel TFT development. Although numerous developments for Cu2O and SnO-TFT have been made so far, their device performances are not satisfactory and still largely behind that for the n-channel TFT. (Fig.1) Therefore, a better understanding of p-channel oxide materials such as electric/defect structure, doping mechanism and the development of p-channel oxide-TFT process including channel defect termination process are indispensable to develop high-performance p-channel oxide-TFT and circuit applications.

Here, the presentation will discuss how we develop high-performance p-channel oxide-TFTs. Firstly, we will review the progress of oxide-TFT technology and clarify the issues of p-channel TFT development. Then we will discuss how we improve the device performances for p-channel oxide-TFTs. Especially, defect termination of p-type oxide channel will be discussed in the detailed.

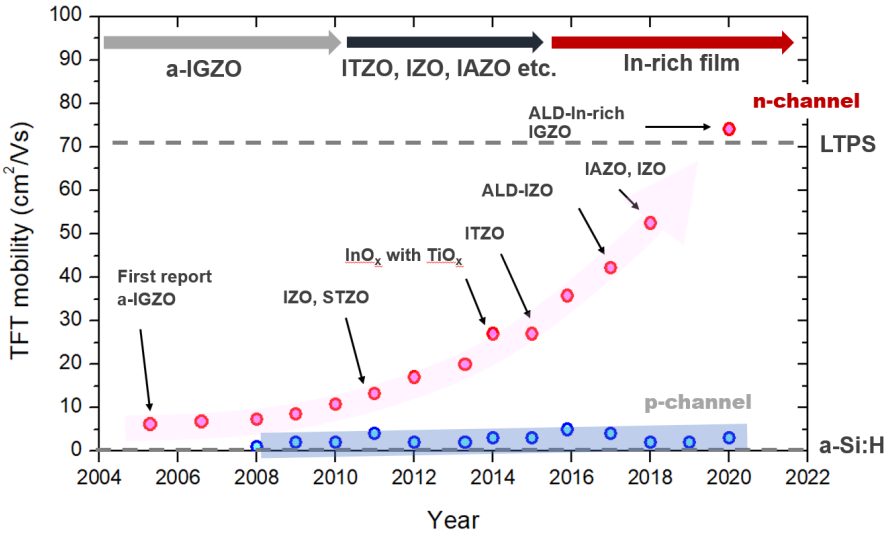

Figure 1 – Progress of TFT mobility for n and p-channel oxide-TFTs.