Application of the PI-VM (Plasma Information based Virtual Metrology) for management of the plasma processes in OLED display manufacturing

S. Park[1,2], T. Cho[1], J. Lee[1], Y. Jang[1], J.-J. Hong[1], W.-H. Jang[1], and G.-H. Kim[2]

[1] *Samsung Display Co., Ltd, Chungcheongnam-do, Korea*

[2] *Seoul National University, Seoul, Korea*

Plasma processes applied to the display- and semiconducting device manufacturing must be monitored by virtual metrology (VM) to maintain the process results and increase the throughput of the processes. Because these processes can be managed according to the VM results, the prediction accuracy of the VM models predicting such as etch- and deposition rate, defect particles, etc. are very important. The core algorithms of the existing VM model are based on statistical methods that analyse the correlation between sensing variables and performance variables in the widely-known big data pool of the fab. However, in identified sensing variables obtained from the engineering equipment system (EES), and other sensors, such as for I-V signal, and optical raw signals, the information about the reacting plasma in the process reactor is not efficiently included. The inclusion of a 'good' parameter, which efficiently contains information about the state of the process, is important for ensuring the accuracy of the VM model; therefore, the performance of a statistical VM, without consideration of the process plasma information, cannot satisfy industrial requirements of prediction accuracy for the high-definition organic light emitting diode (OLED) display manufacturing processes. To enhance the performance of the VM model, three types of reactions in the plasma were parameterized as the core variables of the VM model; therefore, plasma information (PI) parameters representing the reaction properties in the plasma volume, sheath, and surface were applied to the VM algorithm and named as the PI-VM [1]. In OLED display manufacturing processes, PI-VM has shown a noticeably enhanced performance ($R^2 > 90\%$) for the dry etching amount prediction compared to the existing statistical VM ($R^2 \sim 50\%$). In OLED manufacturing fab, various problems occurred during the mass production were predicted and analysed by the application of PI-VM algorithms modelled according to the characteristics of each process plasmas, and they would be introduced in the conference.

[1] S. Park, S. Jeong, Y. Jang, S. Ryu, H. –J. Roh, G. –H. Kim, "Enhancement of the Virtual Metrology Performance for Plasma-Assisted Oxide Etching Processes by Using Plasma Information (PI) Parameters", *IEEE Trans. Semiconductor Manufacturing*, vol. 28, pp. 241-246, August 2015.