Control of the HARC Etching Processes in OLED Display Manufacturing Fab by Using the PI-VM Algorithm

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HARC(High-Aspect Ratio Contact) oxide etching process in also bottleneck technology of the high-definition OLED(Organic Light Emitting Diode) display manufacturing processes like as in the semiconducting device industry. This process requires the high energy ion flux with high verticality near the substrate, because the etched profile is sensitively changed by the incident angle of the bombarding ions. Etching pattern sidewall passivation and loading effect should be considered to control the etched profile, also. These complicated characteristics of the HARC etching resulted in the frequent process faults in the high-pattern density target processes. However, the failure of etching is difficult to predict before the end of the process, and the cause of the process fault is in a black box before the opening of the process chamber. In this study, we had considered the contributions of the detailed mechanisms which govern the reaction rates in the HARC etching plasmas to the fault of the process in the observed mass production line. The EES(Equipment Engineering System) and the additional sensor data were parameterized to the indexes called as the PI(Plasma Information) parameters to include the information about the reaction mechanisms in this process efficiently, and were applied to the design of the VM(Virtual Metrology) algorithm to control the HARC etching processes. Developed PI-VM algorithm could predict the process faults with > 90 % of the accuracy before the process glasses go to the inspection state. This was validated to the mass production datasets accumulated for 3 years. Accuracy guaranteed PI-VM was applied to the cause back-tracking of the process faults. Analysed causes of the faults were matched with the observed problems of the processing devices repeatedly, thus the cause analysing functionality of the established PI-VM was also achieved. According to these functions of the PI-VM, suggestion of the proper solution for the HARC etching failure was possible to manage the high-definition OLED display manufacturing processes more efficiently.