Chapter 5

Conclusion

In this study, we originally and successfully employ the supercritical CO_2 fluids technology to carry H_2O molecule into sputter-deposited HfO_2 film for passivating the defects and surface states at low temperature surrounding (150 °C). With this proposed treatment, the ultra thin, sputter-deposited HfO_2 films present the more completed Hf-O-Hf binding and higher oxygen content. In the investigation on the electrical characteristics of treated-HfO_2 films (the thickness is only 7 nm), the excellent performances of dielectric property are achieved, including the ultra-low leakage current (several-grade lower than conventional sputter-deposited HfO_2 films), the ideal capacitance-voltage curve, the higher dielectric constant (about 30), the better resistance to breakdown and the more stable reliability under high electric field. From these experimental results, the efficiency of applying supercritical CO_2 fluids to deactivate defects is verified. Therefore, this technology agrees to fabricate the high quality dielectric films at low-temperature.

This proposed technology is also used to improve the transfer characteristics of amorphous Si thin film transistors (a-Si:H TFTs) at 150 °C. After supercritical CO_2 treatment, the density of states in the front channel, where is the conduction channel of a-Si:H TFTs, is indeed reduced, especially effective for tail states. Hence, the better sub-threshold swing, lower off-current and higher mobility are obtained, such that the supercritical CO_2 treatment provide a novel method to enhance the transfer characteristics of low-temperature fabricated a-Si:H TFTs.

This proposed technology is also used to improve the transfer characteristics of Non-volatile Memories at 150 °C. From theses experimental results, the ideal capacitance-voltage curve, the better program / erase and retention time are obtained, such that the supercritical CO_2 treatment provide a novel method to enhance the transfer characteristics of Non-volatile Memories.