

Chapter 4

Conclusion and Suggestions for Future Work

4.1 Conclusions

There are many issues as high-k materials directly contact Si substrate. The interfacial layer is unavoidable between high-k dielectric and silicon substrate during high-k materials deposition. Our motivation is that a thin interfacial layer was grown by various surface treatments to improve interface quality prior high-k material deposition.

The method of nitridation or RTO is often used to grow a thin interfacial layer to fabricate stacked gate dielectric MIS capacitor or MISFET. We demonstrate that a ultra-thin oxide growth by ozone water treatment possessed the better quality than nitridation and RTO treatment. It is evidence that the ozone oxide possessed the characteristics as below: dense film, better anti-etching ability, self-limited growth, flat surface roughness. As aluminum oxide directly contacts Si , there is very poor interface quality which induced higher leakage current and poor dielectric breakdown characteristic. According to our study, the ozone oxide can effectively reduce leakage current and better interface quality. The capacitor value can be improved by Post Deposition Annealing process at 900°C due to film crystallization. The samples with ozone oxide followed by RTO can improve the characteristic of leakage current. The ozone oxide with RTO followed by nitridation is unnecessary due to interface states increased.

4.2 Suggestions and Future Work

(1) MOSFET devices fabrication

Mobility degradation, conductance (gm), Id-Vg, Id-Vd and subthreshold swing can be investigated with the device structure and interfacial states are measured quantitatively by charge pumping.

(2) Instrument of ozone generation standing in class 10

There are many particles in class 10k. To grow or deposit the high quality dielectric, silicon surface must be clean and flat. We suggest that the ozone generator must be stood in class 10.

(3) TEM performance

To verify the thickness of interfacial layer and dielectric crystallization, TEM will be executed.

