Chapter 5

Conclusions

5.1 Conclusions

In the first part of this thesis, metal chelators used to move Cu ions were investigated. First, Citric acid and acetic acid have low contact angle, so they were easier to moisten the oxide surface and could uniformly remove copper contamination. In addition to contamination removal, corrosion control is one of important challenges for post CMP cleaning. Hence, corrosion effect of metal chelators on copper surface would be studied. According as experimental results, citric acid has low etching rate for copper, even in high concentration. Hence, it would not damage copper interconnects after cleaning process.

Furthermore, the cleaning efficiency of metal chelators was studied. Citric acid has three carboxyl groups and one hydroxide group that could coordinate with Cu ions. Hence, citric acid has the better cleaning efficiency than acetic acid. However, copper was oxidized to copper oxide in the alkaline environment. Because metal chelators could not chelate with copper oxide, cleaning efficiency would reduce in the alkaline environment.

In the second part of this thesis, we studied the effect of passivation layers on electrical properties of Cu interconnects. First, thermal stability of passivation layers was discussed. According as results of contact angle measurement and TDS analysis, DNNS and PBTC-Na_4 passivation layers would be damaged beyond above 200°C. Because DNNS passivation has the best thermal stability, it would prevent copper oxide formation and reduce Cu ionization. Hence, DNNS passivation could reduce surface leakage current after BTS.

In addition, chemical durability of passivation layers in metal chelators also was discussed. DNNS and PBTC-Na_4 passivation layers almost were not damaged in the alkaline environment of citric acid and acetic acid and were destroyed in higher concentration (0.2M) and lower pH (0.22) of citric acid. In order to prevent damaging passivation layers on Cu surface during post CMP cleaning, we would use 5E^{-4}M citric acid to remove Cu ions. Due to 5E^{-4}M citric acid in the acidic environment has enough ability to remove the most Cu ions, describing in chapter 3.4.4.