The Effect of Inhibitor and Complexing Agents on Cu CMP

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Copper is regarded as the material of choice for interconnects in integrated circuits (ICs) manufacturing due to its low resistivity and high electro-migration resistance. Integration of copper into IC manufacturing process can be implemented by using the dual damascene technique [1-3], in which chemical mechanical polishing (CMP) technique has been applied to remove the overburden material and planarize the wafer surface.

This study aims to improve our understanding of the removal mechanism during copper CMP using hydrogen peroxide based slurries under the influence of various complexing agents and inhibitor at various pH (2 to 10) [4,5]. Potentiodynamic polarization, in-situ open-circuit potential, in-situ linear polarization resistance, and potentiostatic techniques were utilized in this investigation. The affected surface layers of the statically etched Cu were investigated using X-ray photoelectron spectroscopy (XPS) and scanning electron microscopy (SEM). The surface planarity was studied by atomic force microscopy (AFM).

The addition of ethylenediamine(EDA) at acidic pH slurries does not enhance the Cu CMP removal but at basic pH, the CMP removal rate was significantly increased. The surface planarity of Cu at basic pH is improved by the addition of 3-amino-1, 2, 4-triazole (ATA) inhibitor although there is a little compromise in the removal rate. The Cu CMP mechanism with the addition of inhibitor and complexing agents at various pH will be discussed.

Figure 1 shows the CMP removal rates in H_2O_2 based slurries with different kinds of complexing agents and with ATA as the inhibitor. The highest removal is reached with the addition of EDA.

Figure 2 shows the AFM results after Cu CMP in slurries with EDA and glycine as the complexing agents, respectively. The surface finish is comparable with these two slurry compositions while the removal rate is much better when the EDA is added.

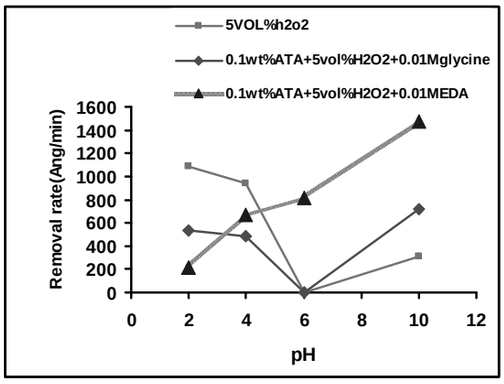
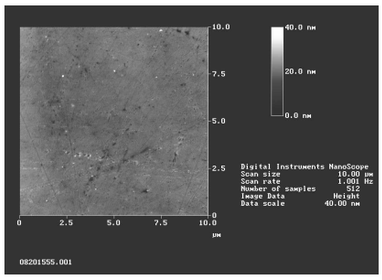
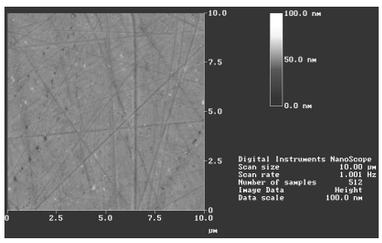


Figure 1. Effect of complexing agents on Cu CMP removal rate with H_2O_2 as the oxidizer and ATA as the inhibitor.





(a)

(b)

Figure 2. ARM morphology of Cu after CMP in slurries with EDA and glycine as complexing agents and ATA as inhibitor.
(a) Glycine+ATA (b) EDA+ATA

References

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