Abs. 948, 206th Meeting, © 2004 The Electrochemical Society, Inc.

# Dispersion Stability and CMP (Chemical Mechanical Planarization) Slurry Characteristics with a point of Micro-Scratch Reduction

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As the resign rule of monolithic circuit decreased, multi-layer interconnection of IC device is essential for fabrication of nano-device. Both global and local planarization should be achieved for multi-layer structure and it is one of the most issued steps in not only semiconductor manufacturing but also MEMS materialization. Although planarization could be attained by various ways such as re-folw, etch-back etc., CMP (Chemical Mechanical Polishing) has been widely adopted since its superior global planarity. However, much problems still exist such as defect/scratch and uniformity as well as contamination and high cost.

In this study, we are to give reduced scratch performance of CMP process with a point of slurry engineering. CMP slurry is typical colloidal dispersion, which includes abrasive particle and chemical additives. Previous studies gave that the CMP scratch is caused by large abrasive particles, which are abnormally larger than average abrasive particle size distribution. However, according to our experience in semiconductor manufacturing, scratch occurrence during CMP could not fully explained by large particle content (LPC) within slurry. Therefore, we focused the source of scratch occurrence with a point of slurry dispersion stability as well as LPC. In order to characterize of the relationship between slurry dispersion stability and CMP scratch, we have used three different dispersant, which is splited by only molecular weight for each slurry. And we measured LPC and centrifugal sedimentation loss (CSL) of each slurry and checked scratch level by polishing test.

As shown in Figure 1, LPC level measured by Accusizer FX for each slurry gave almost same results and LPC level was nearly independent of M.W. of dispersant. However, scratch level of three different ceria slurries was quite different according to Figure 2. It means that the sole LPC level cannot explain scratch level and we should consider other aspects of slurry system.

Therefore, we checked centrifugal sedimentation loss (CSL) for each slurry, which could reflect slurry dispersion stability. For 25ml of slurry, centrifugation was conducted for 2min with 4000rpm. After centrifugation, suspending supernatant was quickly discharged and measured suspension density with densitometer. By comparing with initial density of slurry, sedimented concentration could be calculated and sedimentation portions. As shown in Figure 3, CSL showed well consistent results with our scratch results in Figure 2.

This scratch reduction and improved dispersion stability could be explained by steric barrier thickness of each dispersant as shown in Figure 4. Dispersants used in this study had quite different M.W. and high M.W. dispersant might give higher dispersion stability as shown in Figure 3.

In summary, we have suggested characterization method (CSL), which could reflect slurry stability. CMP scratch was successfully correlated with dispersion stability of CMP slurry, which was tuned by different M.W. of dispersant.

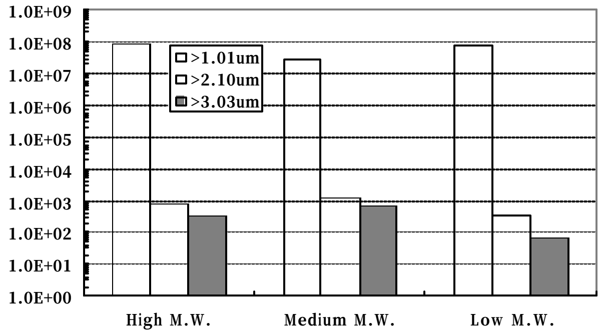

**Fig. 1 LPC (Large Particle Content) measurement by Accusizer-FX according to the dispersant M.W.**

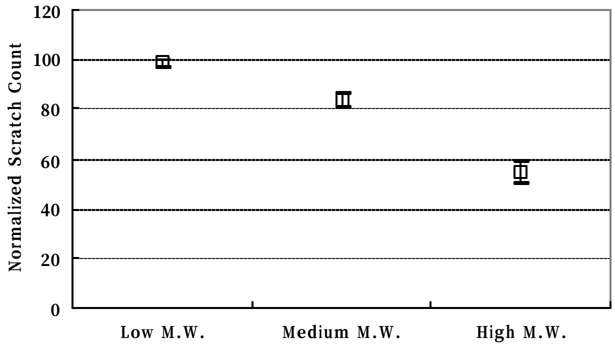

**Fig. 2 Normalized scratch count comparison according to the dispersant M.W.**

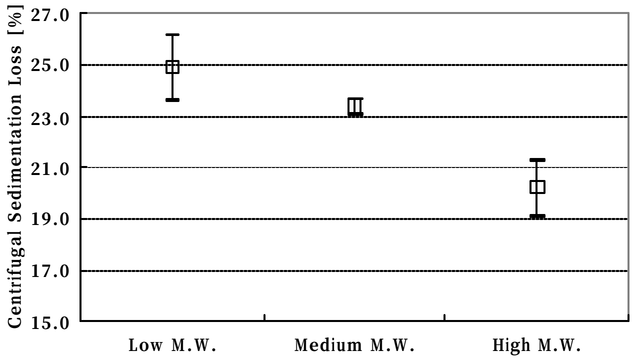

**Fig. 3 CSL (Centrifugal Sedimentation Loss) measurement according to the dispersant M.W.**

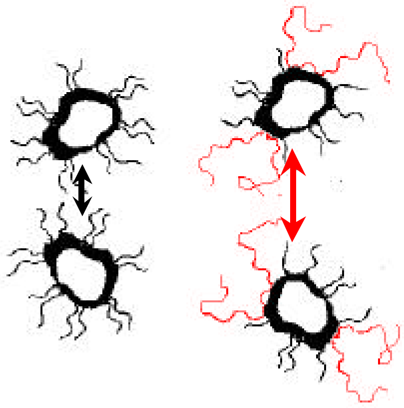

**Fig. 4 Schematic of abrasive dispersion stability by dispersant M.W.**