A Study on Delamination of Low-k Dielectrics during Cu-low k CMP

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Abstract

With the convergence of chemical mechanical planarization and low-k dielectrics for copper dual-damascene interconnects at the 90nm technology node and below, the low-mechanical strength of low-k material can cause delamination during CMP. The potential for delamination will be even greater as IC manufactures adopt increasingly porous ultra low-k films. These ultra low-k materials have correspondingly low strength, as indicated by their low Young’s modulus values and will require new approaches to withstand CMP process. Prevention of delamination requires mild CMP process conditions with desirable removal rates of copper and barrier metal. The mild CMP process condition causes lower frictional force which is affected by a number of factors including polishing parameters such as down pressure and the type of pad etc. Soft pad showed good effect on suppressing low-k delamination during CMP in our experiments.

For the analysis of this phenomenon, friction force and CoF (Friction Coefficient) were evaluated on different type of pad varying polishing condition such as down pressure, relative velocity. Relationship between contact area and contact pressure is also investigated on several types of pad. As shown in Fig. 1(a), CoF does not significantly depend on the pad type. But contact friction force depends more significantly on pad types as shown in Fig 1(b). Thus, it can be concluded that contact area varying with pad type can directly correlated with contact friction force.

![Fig. 1. Comparison of CoF (a) and Contact Friction Force (b) on Different Pad Type](image)