Electromigration Characteristics of Copper Interconnects

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ABSTRACT

Wafer-level electromigration testing was performed on 0.36-µm via size copper dual damascene structures at 290ºC and their voiding characteristics were studied. The resultant resistance increase was dictated by the void that yielded the largest resistance change. 0.36-µm via chain structures which were subjected to a prior thermal treatment at 290ºC for duration of 0–250 hours consistently showed voids in the M2 line, either at or near the cathode end. The predominant occurrence of voiding in the upstream-stressed vias (M2 line voiding) instead of the downstream-stressed vias (via bottom voiding) in the structures was attributed to material replenishment from the Kelvin contacts. The linear degradation of electromigration lifetime with thermal treatment duration is believed to result from a vacancy redistribution process during treatment at elevated temperature that subsequently reduced the time for void nucleation.

Keywords: Electromigration, Copper, Multiple Vias, Dual Damascene, Interconnects

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