

The Influence of Adjacent Segment on the Reliability of Cu Dual Damascene Interconnects

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Abstract – Three terminal ‘dotted-I’ interconnect structures, with vias at both ends and an additional via in the middle, were tested under various test conditions. Mortalities (failures) were found in right segments with jL value as low as 1250 A/cm, and the mortality of a dotted-I segment is dependent on the direction and magnitude of the current in the adjacent segment. Some mortalities were also found in the right segments under a test condition where no failure was expected. Cu extrusion along the delaminated Cu/Si₃N₄ interface near the central via region was believed to cause the unexpected failures. From the time-to-failure (TTF), it is possible to quantify the Cu/Si₃N₄ interfacial strength and bonding energy. Hence, the demonstrated test methodology can be used to investigate the integrity of the Cu dual damascene processes. As conventionally determined critical jL values in two-terminal via-terminated lines cannot be directly applied to interconnects with branched segments, this also serves as a good methodology to identify the critical effective jL values for immortality.