

Copper Ball Bonding Reliability

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Copper ball bonding now represents more than 50% of the total wire bonding market and holds the potential to provide a more reliable interconnection than gold ball bonding. Careful attention and rigorous testing are required to assure this reliability. Gold ball bonding has historically been the standard interconnection method, as few as 10 years ago it represented over 80% of the market. In 2010 the price of gold rose above \$1000/ tr-oz and has remained there. That set off a rapid exit and the adoption of copper as the dominant interconnection material.

Intermetallic (the weld nugget) failure by Kirkendall voids has been the most important failure mode in gold ball bonding. It is accelerated by high temperature (bonding and storage). The development of improved bonding wire alloys (the addition of Pd or Pt in 99% pure gold) delayed the failure. Copper does not have the same failure mechanisms. Copper bonds have a significantly slower intermetallic growth rate and require a much higher temperature for growth so it is a better choice for high temperature environments.

Copper has different failure modes. It is harder, more sensitive to strain hardening, corrodes and is sensitive to ionic halogens. When copper is bonded well and protected from moisture and oxidation by a halogen free (<10ppm ionic content) package it has the potential to be a more reliable interconnection than gold. This talk will focus on the failure mechanisms and reliability of copper ball bonding.