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Reliability assessment and activation energy study of au and pd-coated cu wires post high temperature aging in nanoscale semiconductor packaging

Abstract

Wearout reliability and high temperature storage life (HTSL) activation energy of Au and Pd-coated Cu (PdCu) ball bonds are useful technical information for Cu wire deployment in nanoscale semiconductor device packaging. This paper discusses the influence of wire type on the wearout reliability performance of Au and PdCu wire used in fine pitch BGA package after HTSL stress at various aging temperatures. Failure analysis has been conducted to identify the failure mechanism after HTSL wearout conditions for Au and PdCu ball bonds. Apparent activation energies (Eaa) of both wire types are investigated after HTSL test at 150 °C, 175 °C and 200 °C aging temperatures. Arrhenius plot has been plotted for each ball bond types and the calculated Eaa of PdCu ball bond is 0.85 eV and 1.10 eV for Au ball bond in 110 nm semiconductor device. Obviously Au ball bond is identified with faster IMC formation rate with IMC Kirkendall voiding while PdCu wire exhibits equivalent wearout and or better wereout reliability margin compare to conventional Au wirebond. Lognormal plots have been established and its mean to failure (t50) have been discussed in this paper.

Keywords

Apparent activation energy; Arrhenius plot; High temperature storage life; Lognormal plot; Semiconductor device; Wearout reliability