Effect of Compressive Stresses in Anisotropic Conductive Films (ACFs) on Contact Resistance of Flip Chip Joint

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Abstract

The important conduction mechanism of anisotropic conductive films (ACFs) is the joint clamping force after curing and cooling-down processes of ACFs. In this study, the mechanism of shrinkage and contraction stresses and the relationship between these mechanisms and the thermo-mechanical properties of ACFs are investigated in detail. Both thickness shrinkages and modulus changes of four ACFs with different thermo-mechanical properties are experimentally investigated with thermo-mechanical and dynamic mechanical analysis. Based on the incremental approach to linear elasticity, contraction stresses of ACFs developed along the thickness direction are estimated. It was found that contraction stresses in ACFs were significantly developed during the cooling process from the glass transition temperature to room temperature. Moreover, electrical characteristics of ACF contact during the cooling process indicates that the electrical conduction of ACF joint is robustly maintained by large contraction stress below T_g. The increasing rate of contraction stresses below T_g was strongly dependent on both thermal expansion coefficient (CTE) and elastic modulus (E) of ACFs. A linear relationship between the experimental increasing rate and E×CTE reveals that the build-up of contraction stress is closely correlated with the ACF material properties: thermal expansion coefficient, glassy modulus, and T_g.