Simulation of Diffusion Controlled Intermetallic Formation of Au/Al Interface

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Abstract

This paper describes the finite element simulation for diffusion controlled intermetallic formation of Au/Al interface during the wire bonding process. The analogous correlation between the intermetallic atomic diffusion and the heat transport is introduced, and the simulation of intermetallic diffusion using a commercial finite element method (FEM) tool ANSYS is demonstrated. Phase dependent diffusivities have been implemented into the material model in order to more accurately model the distribution of diffusing species concentration. The various phases of intermetallic compounds (IMCs) can be determined briefly by the obtained atomic concentration profile from FEM and the phase composition table. The overall thickness of the IMCs layer can then be calculated. In this paper, the concept for the subsequent stress analysis based on the volume change due to diffusion is also discussed.

1. Introduction

W3 Tm[( )s a þ1.

used as an initial analysis in the subsequent FEM modeling.

Table 2, Material data of Au/Al compounds

Compound	**Composition (at. % Au)**	**Activation energy (eV)**	**Diffusion coefficient ($\mu m^2/s$)**	**Density (g/cm^3)**
Au	84-100			

For intermetallic growth, on the one hand, it is a common belief that during the growth of compounds, the interfacial stresses and stress gradients serves as additional driving force to accelerate

$$V \frac{1}{3V} \frac{dV}{dC}$$

multi-component systems with stoichiometric phases," *Acta Materialia*, vol. 58, pp. 2905-2911, 2010.

[15] J. Svoboda, E. Gamsjäger, F. Fischer, and E. Kozeschnik, "Modeling of kinetics of diffusive phase transformation in binary systems with multiple stoichiometric phases," *Journal of Phase Equilibria and Diffusion*, vol. 27, pp. 622-628, 2006.

[16] T. C. Illingworth 19(a)-13(tio)-3(n)a-5(8213(llin( )-809(I)-3O.)-183(I)-3G(ze)-l(ich)s)(tio)-[(Ko5,e)] o14 9.96 Tf1 0 0