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Investigations on Microstructure and Mechanical Properties of the Cu/Pb-free Solder Joint Interfaces

Doctoral Thesis accepted by
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Supervisor's Foreword

Soldering is the most widely used joining technology in microelectronic package, and the mechanical properties of the solder joints are important influencing factors on reliability of the microelectronic devices. With the increasing requirement on performance of the microelectronic device, the solder joints service in more and more severe environments; however, the understanding on damage behaviors of Pb-free solder joints is still lacking. Therefore, it is necessary to investigate the mechanical properties and damage mechanisms of the Pb-free solder joints for evaluating their reliability.

For this reason, in this study Dr. Zhang has designed a series of experiments to simulate the loadings suffered by the solder joints; the investigations include the fracture behavior of the interfacial IMC layers at the Cu/Pb-free solder interface, the tensile-compress fatigue damage behavior, creep-fatigue behavior, and thermal fatigue behavior of the Cu/Pb-free solder joints. Some innovative designs on mechanical property test method of the solder joints are applied, the damage behavior of the solder joints under different conditions are revealed, and the influences of interfacial microstructure, strain, stress, and temperature are comprehensively discussed. Overall, this work contains valuable information on reliability evaluation of the Pb-free solder joints.

Shenyang
September 2015

Prof. Zhefeng Zhang

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Nomenclature

E	Tensile elastic modulus (Pa)
G	Shear modulus (Pa)
Q	Active energy (J)
R	Gas constant (J/mol K)
T	Temperature (K)
F	Force (N)
r	Radius (–)
b	Burgers vector (–)
S	Stress amplitude (MPa)
N_f	Fatigue life (–)

Greek Symbols

σ	Tensile stress (MPa)
ε	Tensile strain (–)
v	Poisson ratio (–)
τ	Shear stress (MPa)
π	Constant (–)
γ	Shear strain (–)