

Preface

Green electronic products require the use of lead-free (Pb-free) solder materials for soldering. Semiconductor packaging and electronics manufacturing employ Pb-free solder for silicon chip interconnection and surface mount assembly of integrated circuit (IC) components on a printed circuit board (PCB). Design and reliability evaluation of Pb-free soldered assemblies involves multidisciplinary knowledge in Pb-free solder material, its mechanical properties, manufacturing compatibility with IC components and PCB materials, quality of soldering process and solder joint reliability performance in service.

The global electronics manufacturing industry has made a critical shift to Pb-free solder materials and soldering technology after more than 40 years of use of tin–lead (Sn–Pb) solders. Since July 2006, the European Commission Directives on “Waste Electrical and Electronic Equipment (WEEE)” and on the “Restriction of the use of certain Hazardous Substances (RoHS)” in electrical and electronics equipment has resulted in a global shift to RoHS compliant Pb-free electronic products. The electronic manufacturing industry has since successfully implemented Pb-free solder technology. In America, the National Electronics Manufacturing Initiative (NEMI) organization recommended the use of Pb-free, tin–silver–copper (95.5Sn–3.9Ag–0.6Cu) solder alloy for solder reflow process and tin–copper (99.3Sn–0.7Cu) solder alloy for wave soldering. However, it is now common practice to use different variations of tin–silver–copper (SAC) solder alloys, namely SAC305, SAC387, and SAC405, respectively.

This book on “*Lead Free Solder: Mechanics and Reliability*” provides a comprehensive knowledge base for Pb-free solder mechanical properties, materials constitutive models, fatigue life prediction models, finite element modeling, and simulation of reliability test results. Application of Pb-free solders requires advance mechanics of materials characterizations, computational modeling and simulation of reliability tests subject to thermal cycling test, vibration fatigue test,

and board-level drop impact test conditions. The tensile, creep, and fatigue properties for 95.5Sn–3.8Ag–0.7Cu (SAC387) and 99.3Sn–0.7Cu solder materials are covered in detail and compared to other solder alloys. Mechanical properties and constitutive models were derived for use in finite element analysis to predict solder joint reliability in a design-for-reliability (DFR) methodology.

John Hock Lye Pang, PhD, ASME Fellow

Lead Free Solder

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Pang, J.H.L.

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