Master's Thesis Defense Announcement
Mechanical and Aerospace Engineering Department
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Evaluation of thermal cycling reliability
on different solder alloys of BGA (Ball Grid Array) package -
A Comparative FEA (Finite Element Analysis) Study

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Abstract

Solder joint reliability in Ball Grid Array (BGA) packages has become a critical issue in electronic manufacturing. This thesis specifically characterizes three different lead-free solder alloys (Pure Indium, SAC-387, and SAC-Q) in BGA solder joints using two different printed circuit board (PCB) thicknesses (1mm and 0.7 mm). The analysis considers the non-uniform temperature distribution caused by the main heat source, the die, and the resulting deformation of the package due to the mismatch in the coefficient of thermal expansion (CTE) between components used in BGA. Finite element (FE) models are created in ANSYS mechanical package environment to predict stress distribution, plastic work, and the number of cycles to failure for different solder alloy compositions. Volume-averaged plastic work is calculated using an APDL script in ANSYS commands, utilizing stress and strain values from the FEA models. This research aims to evaluate the thermal reliability of solder alloys in BGA packages, as solder joint failures can result in device malfunctions or failures, leading to significant financial losses and reputational damage for electronic manufacturers. The findings of this study can contribute to the development of more reliable and durable electronic devices.