UQÀM ÉCOLE POLYTECHNIQUE MONTRÉAL

TechnoCap DreamWafer Division

Thermo-Mechanical Analysis of a Reconfigurable Wafer-Scale Integrated Circuit

LIMA: Laboratoire d'Ingénierie des Microsystèmes Avancés

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Abstract

This paper presents thermo-mechanical investigation results of a reconfigurable wafer-scale integrated circuit, the WaferIC™, dedicated to electronic systems prototyping. The proposed approach carefully selects materials combined with an active cooling mechanism to avoid critical localized thermal peaks and associated large thermal stresses. The performance of the approach was evaluated and tested using finite element methods and steady state thermo-mechanical results are provided. During the development of the WaferIC, the thermo-mechanical design aspects were proven crucial to its reliable operation

DreamWafer Technology

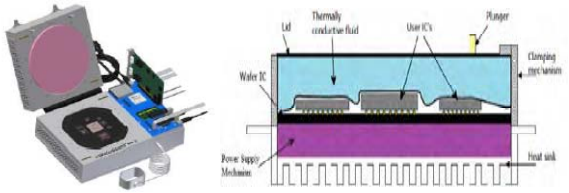

Fig. 1: A 3-D model of the WaferBoardTM: the black surface is a the WaferICTM assembly. B: WaferBoard™ cross-section model

Partially Coupled Fluid-Heat Transfer Approach

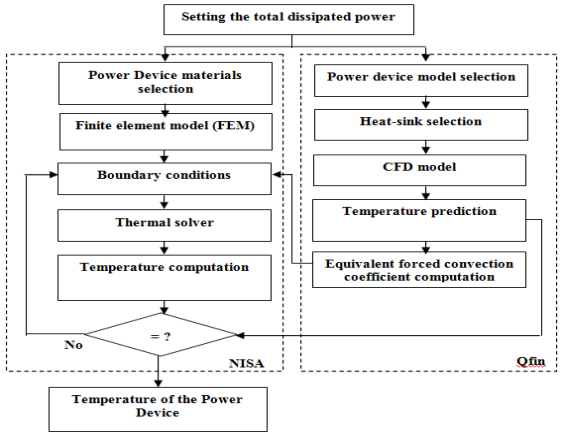

Fig 2: Flow Chart of Mixed Fluid-heat Transfer Approach

Thermo-mechanical analysis

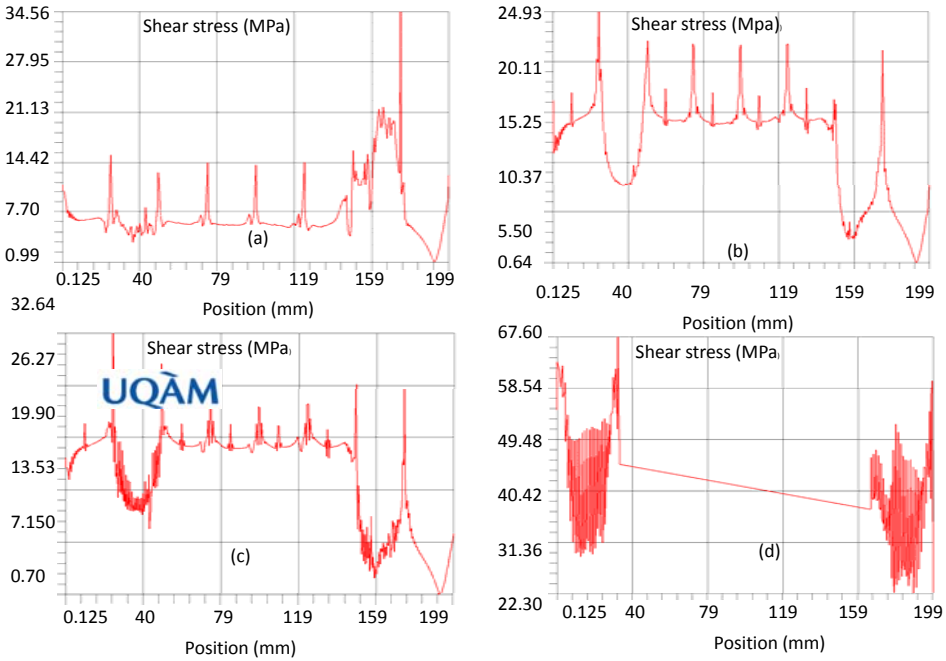

Fig 3: Sandwich forced convection through PCB surfaces simply supported in the bottom - SHEAR STRESS: a) - Bottom solders balls-WaferIC, b)Y1-Top solders balls-WaferIC, c) Y1-Top WaferIC, d)Y1- Bottom components

Conclusion

In this paper, an approach to evaluate and predict a steady state thermo-mechanical behavior of reconfigurable wafer-scale integrated circuit was presented. The main objective of this study was to explore possible thermo-mechanical problems during the design phase of a wafer-scale integrated device. The developed method combines FEM and mixed fluid-heat transfer approach for analyzing thermo-mechanical stress, distortion and warpage. Furthermore, a thermo-mechanical approach was presented to evaluate thermal stress and distortion in electronic devices. The reported analysis identifies the most important factors that could contribute to the device's thermal failure and show how their effects can be simultaneously considered.

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