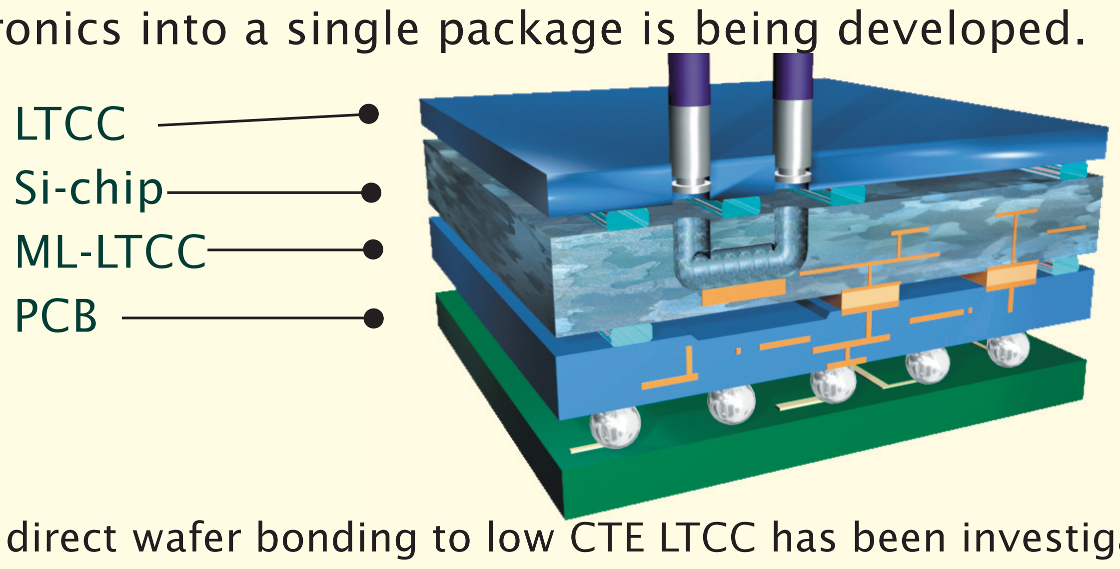
LTCC Packaging for Microsystems

Katrin Persson, Cristina Rusu, Britta Ottosson

Imego AB, Arvid Hedvalls Backe 4, SE-411 33 Göteborg, Sweden

Introduction

A novel packaging platform for the integration of sensors, actuators, fluidic and optical elements together with electronics into a single package is being developed.



Silicon direct wafer bonding to low CTE LTCC has been investigated.

Conclusions

- Silicon and LTCC show similar behaviour when used for packaging (low pressure inside the package) while glass tends to be poorer.
- The new low CTE LTCC technology opens up the possibility of direct bonding between MEMS wafers and LTCC substrates.
- The prospect of using LTCC as substrate allows for cheaper chip/wafer scale packages, which in turn can become an essential factor in bringing MEMS products to a mass-market.

Simulation

- Static deformation results from ANSYS using SOLID92 hexahedral elements.
- Anodic bonding at 420ºC.
- The thickness of the wafers is 300 µm and 500 µm for silicon and LTCC/glass respectively.
- The stress was evaluated at room temperature.
- Vacuum sealing has been simulated in the case of cavities in the middle silicon wafer.

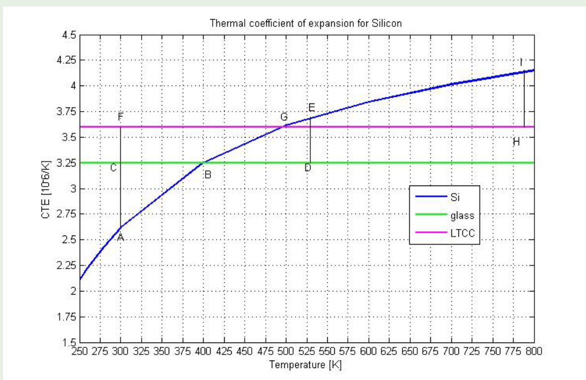


Figure 1. Thermal expansion coefficients of silicon, LTCC and borofloat 33 glass.

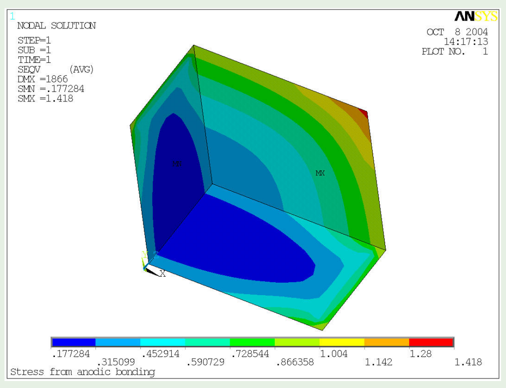


Figure 2. Equivalent von-Mises stress in the middle silicon wafer at room temperature after anodic bonding with LTCC on both sides at 420ºC.

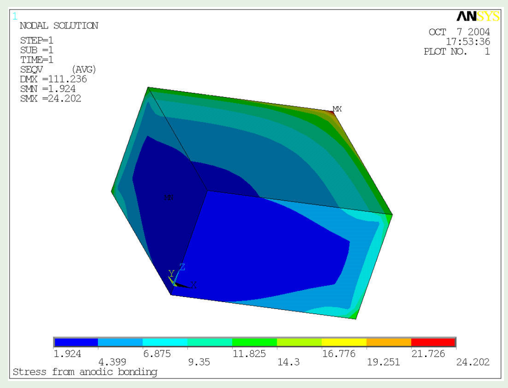


Figure 3. Equivalent von-Mises stress in the middle silicon wafer at room temperature after anodic bonding with glass on both sides at 420ºC.

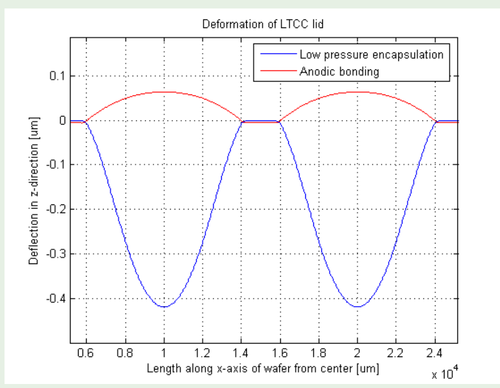


Figure 4. Deformation after anodic bonding at 420ºC (upper curve) and deformation due to vacuum sealing (10-3 mbar) (lower curve) of 500 µm LTCC to silicon. Cavity size 8 x 8 mm^2.

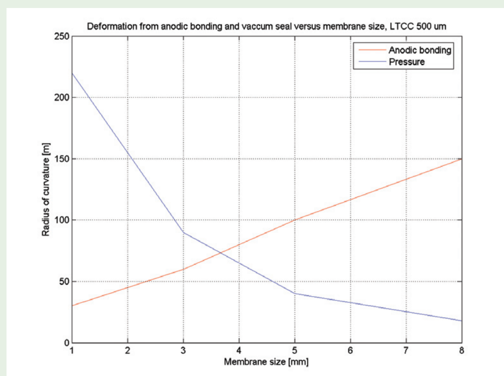


Figure 5. Graph of the magnitude of the radius of curvature at low pressure encapsulation and anodic bonding versus silicon cavity size for 500 µm LTCC. Bonding area is 1 mm at each side.

Experimental

- The new low CTE LTCC material gives the opportunity of direct wafer bonding to silicon.
- The material contains alkali ions which allows for direct anodic bonding to silicon.
- 2” low CTE LTCC wafer was bonded to silicon by standard anodic bonding at 420 ºC, 800 V and a few seconds.

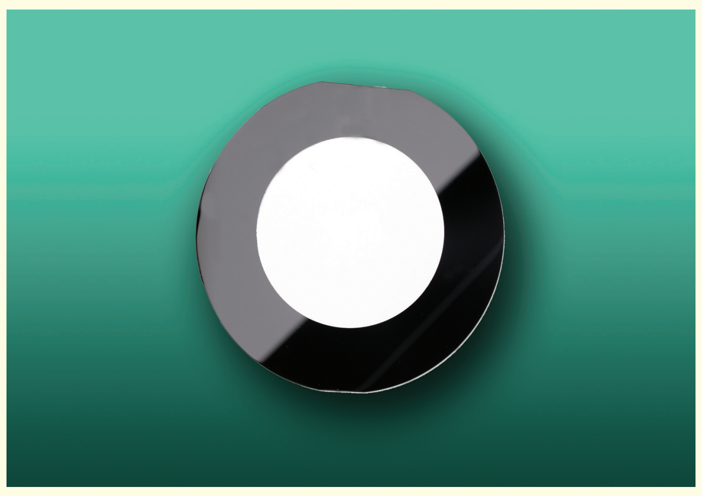


Figure 6. LTCC anodically bonded to a silicon wafer.

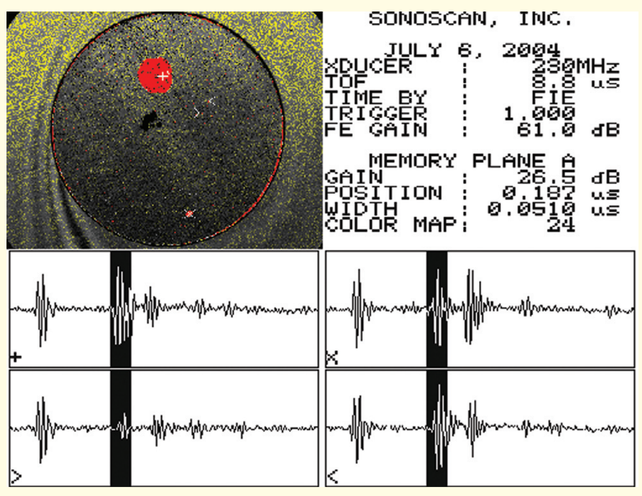


Figure 7. SAM, scanning acoustic microscopy, image of the interface between LTCC and silicon. Voids are indicated by red regions.

Acknowledgements

The authors would like to acknowledge Via Electronics and HITK for supplying the LTCC samples for anodic bonding evaluation.

Contact

Katrin Persson
Imego AB, Arvid Hedvalls Backe 4
SE-411 33 Göteborg, Sweden
E-mail: katrin.persson@imego.com
www.imego.com