Physics-Based Reliability of Dielectrics on Alternate Base Substrates

Student: Shashikant Hegde, Weidong Xie Post-doc: Raghuram Pucha Faculty : Suresh Sitaraman

Objectives

• Develop physics-based models to evaluate alternate base substrates and low-stress dielectrics to enhance reliability

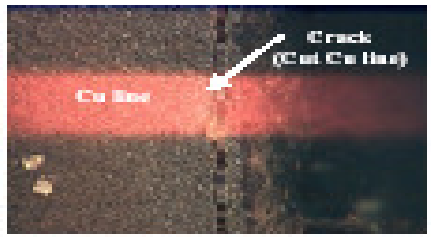
• Explore a combination of base substrate materials and interlayer dielectric materials such that warpage is minimal, dielectric will not crack, and flip-chip solder joints, assembled without an underfill, will not crack prematurely during qualification regimes and operating conditions.

• Recommend appropriate geometrical and material properties for SOP HDW substrates in meeting the next generation packaging requirements.

Approach

•Experimental, Analytical and Numerical Techniques to evaluate Thermomechanical Reliability of various dielectric and base substrate materials.

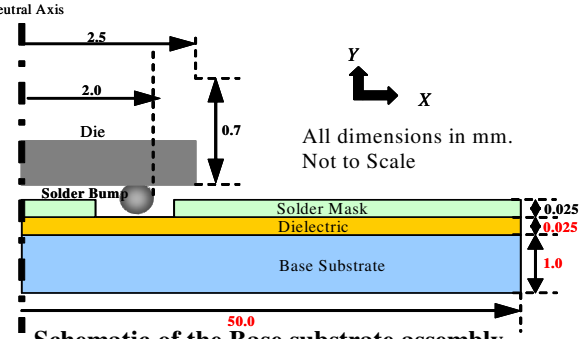
•Perform Design of Simulations to generate a response surface to study the contributions of parameters such as dielectric thickness, modulus and CTE to thermomechanical failures such as film cracking, solder joint failures and excessive warpage.



Dielectric Cracking cutting through Cu

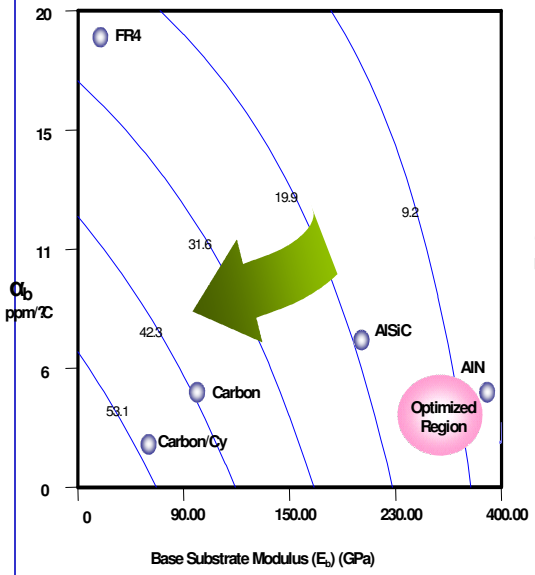
Accomplishments

- Developed analytical and computational models to evaluate various base substrate and dielectric materials with respect to warpage and dielectric cracking.
- Conducted design-of-simulations in arriving at optimized theromo-mechanical properties for the base substrates and dielectric materials.
- Compared the modeling results with the ongoing experimental trends in base substrate program
- Conducted experiments in evaluating dielectrics (from Hitachi Chemicals) in combination with various alternate base substrates.

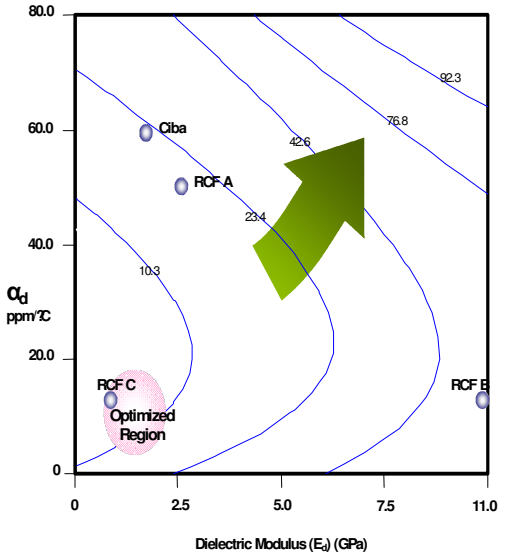


Schematic of the Base substrate assembly

Results



Response surface of warpage (µm) shown against base substrate material properties.



Response surface of film stress (MPa) shown against dielectric material properties.