An Integrated Process Modeling Methodology and Module for Sequential Multilayered Integrated SOP Substrate Fabrication - I

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OBJECTIVES

- Understand the complex curing behavior of next generation interlayer dielectric materials
- Thermo-physical and thermo-mechanical characterization of the said materials
- Investigate the evolution of warpage and internal stresses in the sequential build up of a multi-layer High Density Wiring (HDW) substrate that uses low CTE, high modulus base substrate with a low stress interlayer dielectric
- Investigate the reliability of microvias in HDW substrates built with alternative dielectric and base substrate materials
- Understand the failure mechanisms associated with alternative materials and develop design and process guidelines for the next generation SOP substrates

APPROACH

- Employ generalized-deformation (pseudo-3D) and 3D finite element models with element activation/deactivation to simulate the addition/removal of material layers during the sequential build-up fabrication process
- Conduct comprehensive thermal and mechanical characterization of the thin film interlayer dielectric material, and develop models for the cure kinetics, cure shrinkage and cure-dependent viscoelastic stress relaxation modulus
- Develop an full-coupled Cure-Thermal-Stress analysis module and methodology, inclusive of the cure-dependent mechanical properties
- Perform full-field warpage measurements during the PDDF curing process on several base substrate materials, using Shadow Moiré interferometry, to validate the process models

ACCOMPLISHMENTS

- Developed an integrated process modeling methodology and module using a coupled cure kinetics-thermal-stress analysis approach for simulating the fabrication of the multilayered SOP substrate
- Incorporated exothermic heat liberated during curing, cure-induced shrinkage and cure-dependence of viscoelastic material properties through user-developed subroutines
- Experimentally validated the in-situ warpage and residual stress from the SOP substrate fabrication process models.
- Papers published in ASME Transactions, ECTC