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

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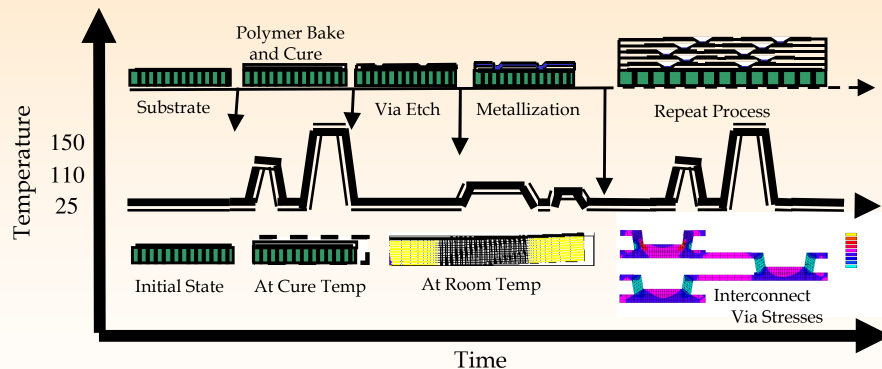
OBJECTIVES

- 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

PROCESS FLOW OF SOP SUBSTRATE FABRICATION



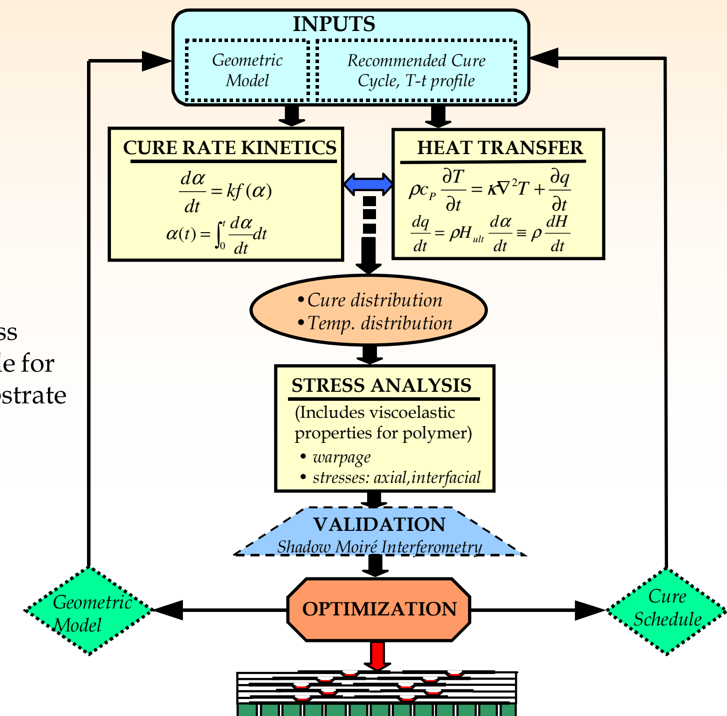
ACCOMPLISHMENTS

- 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

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 Moire interferometry, to validate the process models

Schematic of the Integrated Process Modeling Module for multilayered substrate fabrication



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