Foil-Based Transient Liquid Phase Bonding Systems

COOLING TECHNOLOGIES RESEARCH CENTER

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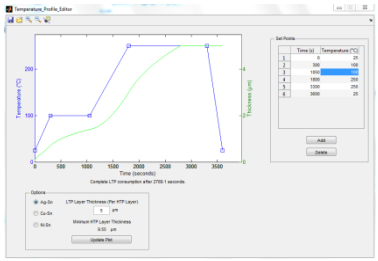
Background

Transient liquid phase bonding (TLPB) is being investigated as an alternative to high-Pb solders, sintered Ag, and thermal interface materials. A low melting temperature metal, such as Sn, reacts with a higher melting temperature metal to form intermetallic compounds that are stable at temperatures greater than the initial processing temperature. TLP bonds will facilitate high operating temperatures and hierarchical soldering.

Objective

The objective of this project is to apply fundamental materials science concepts such as thermodynamic, kinetic, and microstructural analysis to the development of improved TLPB formulations and processing guidelines. Potential Sn alloys for Cu, Ni, and Ag interconnects will be assessed using existing thermodynamic databases. Short duration processing times are desirable for commercial applications. Measurement of growth kinetics will be performed to develop more detailed guidelines. Finally, microstructural features and their relationship to mechanical and thermal performance as a function of alloy composition, bond geometry, and processing conditions will be assessed.

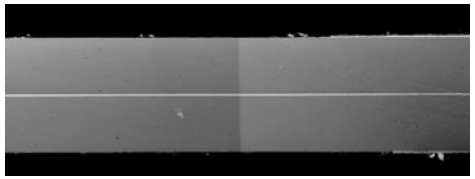


1D calculator available to predict processing conditions required for different alloys, substrates, and Availability of the TLPB modeling tools may be extended to other applications, including TSV micropillars and die attach.

Approach

- Create and disseminate kinetic and thermodynamic guidelines for designing multi-component TLPS systems and alloys.
- Develop optimized composition, and processing guidelines for three binary systems and at least two ternary TLPB systems.

TLPB: Formation of thin bond lines for model experiments



Uniform, dense bondlines fabricated with thicknesses in the range of 3-10 µm are needed for heat-rail attach in power electronics.

Impact

Developing modeling tools to predict such geometries and microstructures will help materials and process designers tailor structures for specific applications. with the aim of improving the processability, bond quality, phase stability, and thermal conductivity of TLPB systems. The TLPB modeling tools may be extended to other applications, including TSV micropillars and die attach.

PURDUE MATERIALS ENGINEERING