APPLICATION NOTE

InFORCE™MF (908-38-1)

Ag Sinter Paste for Die-Attach

Introduction

InFORCE™MF pressure Ag sinter paste has been specifically formulated for dry placement sinter process. The target application for this material is for die attach-to-substrate in power electronics. **InFORCE™MF** can be used on silver, gold, and bare copper surfaces (multi-finish) and offers a number of benefits that help to maximize throughput in high-volume manufacturing, including:

- Fast printing speeds
- Fastest drying times possible
- Hot die tack or tacking agent compatible
- Sinter pressure 10–20MPa

Storage and Handling

InFORCE™MF should be stored at sub-zero °C temperatures. Below -10°C is recommended to ensure the shelf life. Following low-temperature storage, sufficient resting time is required before use. Allow a minimum of 8 hours or overnight "thawing" before use. Some mixing is necessary before use to re-homogenize the paste.

Process Flow

Recommended process flow for die-to-substrate application:

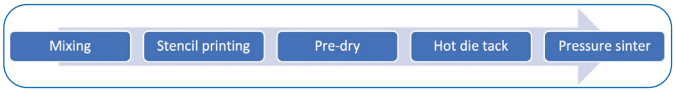

Figure 1. Process Flow Diagram.

Mixing

After thawing it is normal to observe some separation of the silver content and the binder. Re-homogenization should be done by using a planetary centrifugal mixer or similar.

- Exact mixing parameters will depend on the equipment used. An example process for a Thinky mixer is 2 minutes at a maximum of 700 rpm.

Stencil Printing

InFORCE™MF performs best with print speeds between 50 and 100mm/s. The paste should be observed to be "rolling" during the print stroke for optimal aperture fill. Slow separation speed is recommended to ensure good print definition and to prevent "dog ears" at the edges. Parameters may need to be adjusted based on number of deposits, aperture shape, and dimensions.

Recommended Starting Parameters:

- Print speed: Between 50–100mm/s
- Print pressure: 4kg (increase if excessive paste remains on the stencil)
- Separation speed: less than 1mm/s (reduce if edge definition is poor or "dog ears" are observed)

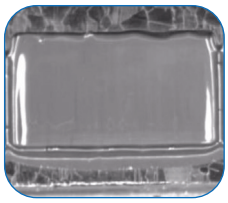

Figure 2. Smooth print deposit at >100mm/s.

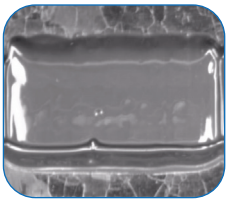

Figure 3. Dog-eared edges due to excessive separation speed.

Pre-Dry

Pre-dry must be optimized for sufficient solvent evaporation. **InFORCE™MF** is formulated for fast drying times. Paste deposit thickness should be considered when establishing drying times. For thickness <100um, dry for 5–10 minutes; for thicker deposits >100um, dry for 10–15 minutes. It is necessary to reach temperatures of 140–150°C when pre-drying **InFORCE™MF** due to the fast-dry solvents in the formulation. Drying profiles should be verified with a temperature recorder or thermocouple. Dry under N_2 to prevent oxidation when bare copper surfaces are to be sintered. Longer drying times may be necessary when drying under N_2. Drying time starts when temperatures above 140°C are reached.

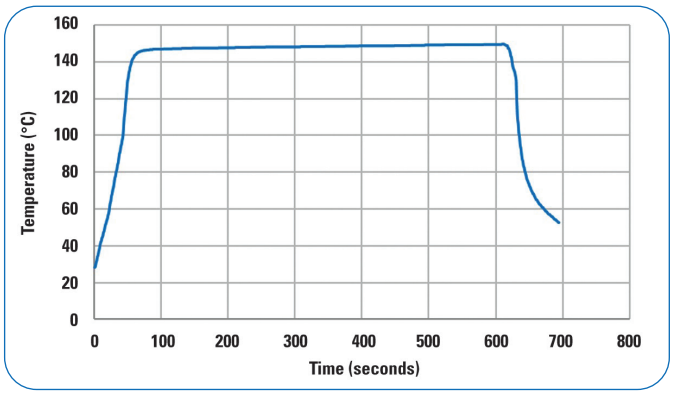

Figure 4. Drying profile: 10 minutes @ 150°C.

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INDIUM CORPORATION®

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Hot Die Tack

InFORCE™MF performs very well in a hot die tack process when heat and pressure are applied during die placement. Process time will depend on the capability of the die bond equipment to reach the set bond pressure. Lower temperatures have less oxidation risk when bare copper surfaces are used. Temperatures and bond pressure may need to be increased for Au surfaces.

Recommended starting parameters for Ag surfaces:

- Substrate temperature: 100°C
- Bonder head (nozzle) temperature: 120°C
- Bond pressure for Ag-coated die: 1MPa (+/- 0.5)
- Bond pressure for Au-coated die: 1–3MPa
- Bond time: 150ms – 1s (must be adequate to reach the set pressure)

Pressure Sinter

InFORCE™MF should be sintered for 3 minutes (180 seconds) at temperatures between 250–270°C with pressures of 10–20MPa, depending on surface finish. The following conditions yield very high shear strengths >50MPa for 5 x 5mm die:

- All Ag surfaces: 3 minutes, 250°C @ 10–20MPa under air or N_2
- Bare copper surface: 3 minutes, 270°C @ 15–20MPa under N_2

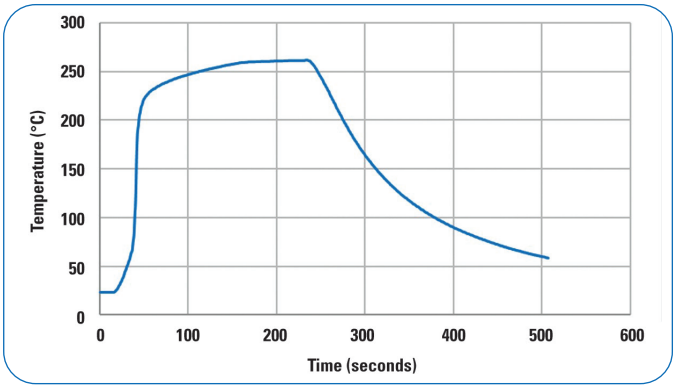

Figure 5. Sinter profile: 3 minutes, 260°C @ 20MPa.

BLT Post-Sintering

Due to the **InFORCE™MF** high metal loading, the reduction in bondline thickness from wet paste to post-sinter is approximately 50%.

Typical Post-Sinter Properties

InFORCE™MF Properties	
Melting Point (°C)	961
Electrical Resistivity (μΩ.cm)	5
Thermal Conductivity (W/mK)	280
CTE (ppm/K)	19

Summary

InFORCE™MF is targeted for power module, die-attach application. Due to the fast process times, an increase in throughput can be achieved compared to other Ag sinter pastes. For the best results, the recommended process parameters should be used as a starting point and adjusted where necessary. Parameter settings outside of the specified ranges may be necessary in some cases. Indium Corporation's experienced applications and technical support team are on hand to offer any guidance that is needed.

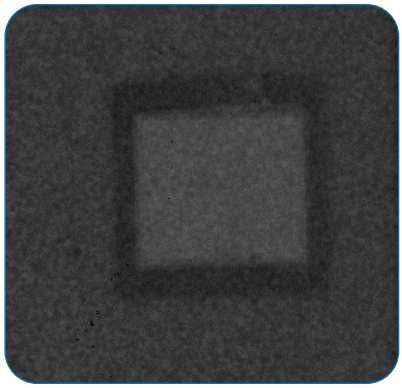

Figure 6. CSAM 9x8mm die, Ag back metal on Ag-plated substrate.

All of Indium Corporation's solder paste and preform manufacturing facilities are IATF 16949:2016 certified.
Indium Corporation is an ISO 9001:2015 registered company.

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