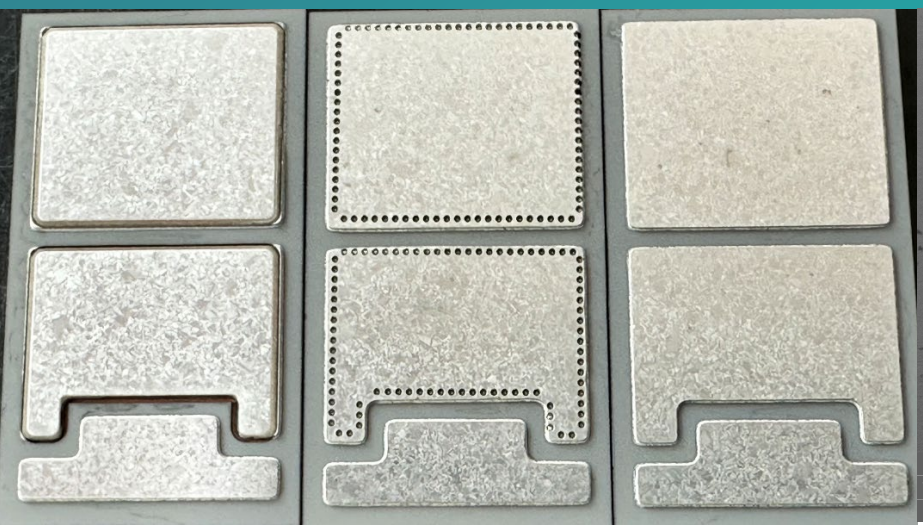
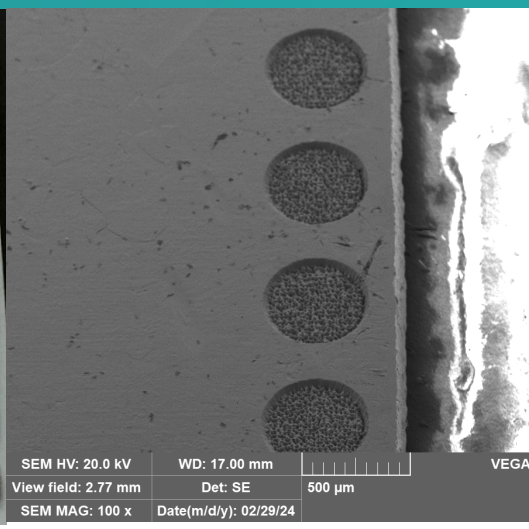
Technology Theme:
LASER PROCESSING / ELECTRIFICATION

CIRCUIT BOARD MICRO-FEATURES GENERATED WITH LASER ABLATION: ELECTRONICS MANUFACTURING





CIRCUIT BOARD MICRO-FEATURES GENERATED WITH LASER ABLATION

The MTC successfully developed a laser ablation process for creating precise, micro scale features in active metal braze (AMB) substrates that enable advancements beyond the conventional design rules for these components and improved mechanical performance.

> The excellent work done by the MTC has allowed us to develop unique features which we hope will increase the reliability and bond strength of populated power substrates, whilst also resulting in more compact, more reliable and lower inductance circuit designs than currently possible due to the limitations of chemical etching.
>
> **Rob Rhodes, Commercial Director, SGA Technologies, Lead Project Partner**

THE CHALLENGE

- Power electronics substrates are typically manufactured using an active metal braze (AMB) process whereby two layers of copper are bonded to either side of a ceramic sheet. Due to the thermal cycles that the components are exposed to, they are subject to significant stresses.
- The current manufacturing method for removing copper on the substrates, to create the desired circuitry designs, is photochemical etching. This offers little design freedom, due to the need for masking and leaving a large taper on the remaining copper.
- An alternative process is required that can enable more selective copper removal and enable finer features to be created, unlocking innovation in substrate design.

MTC'S SOLUTION

- Laser processing offers a viable alternative solution for selective removal of copper from these components.
- An ultrashort pulsed (USP) laser can be used to create a variety of intricate features in the copper that offer benefits in stress relief, track design and improving the bond between component and substrate.
- The laser generated features are impossible with a conventional etching process as the etching process removes any exposed copper, unless masked.
- Using USP lasers ensures that copper oxidation is kept to a minimum and thermal induced damage to the substrate is avoided.

This project was funded as part of the first round of Advanced Propulsion Centre's (APC's) Scale Up Readiness Validation funding from the Automotive Transformation Fund (ATF).

THE OUTCOME

- 50 µm features were successfully produced in the AMB substrates using an ultra-short pulsed laser.
- A track design was generated in the substrates that achieved great quality compared to the traditional photochemical etching process, the taper reduced by 33%, enabling finer track designs in the future.
- Stress relief features were successfully machined into substrate pad edges with an improvement in performance expected.
- Laser textures were ablated into the copper, these were then plated, and provided an effective solder stop and an ability to significantly control the wettability of the solder.
- The laser ablated substrates were validated through completion of 1000 thermal shock cycles.

BENEFITS TO THE CLIENT

- The MTC's highly experienced laser processing team were able to identify the most suitable laser machining process to use for this application.
- Having a wide variety of laser equipment enabled the project partner to de-risk any future outlay on this technology.
- Alongside this, having experience in electrification and process scale up has provided valuable insight to the project partners
- The processes developed as part of this project provide SGA Technologies with a unique selling point for their AMB substrates as they take them to market.

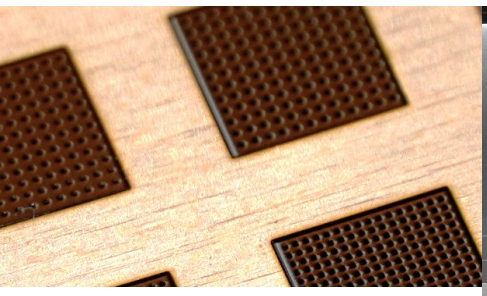
> The MTC has showcased a groundbreaking capability in laser ablation, achieving features that not only diminish thermal stresses and enhance control of solder joint wetting and solder stop but also minimize track wall taper. This reduction in track wall taper enables a narrower track gap width, providing greater design freedom.

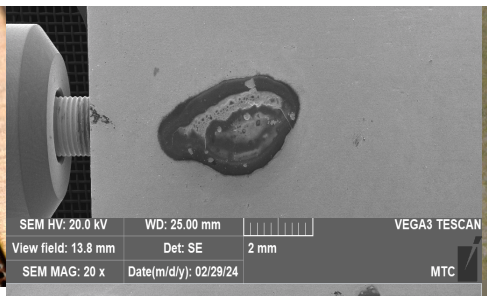
Shan Dulanty, Chief Engineer, MTC

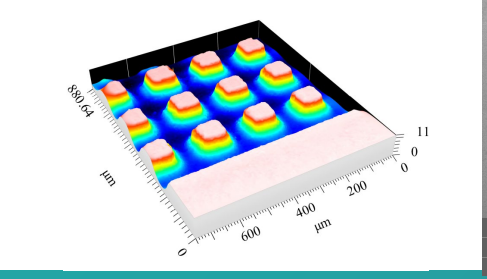
0.66mm
Track and gap width possible for the circuit design with laser ablation

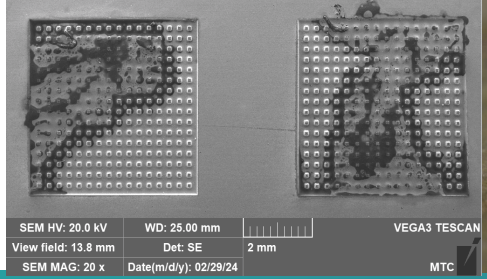
↓33%
Reduction in track wall taper from laser compared to conventional etching

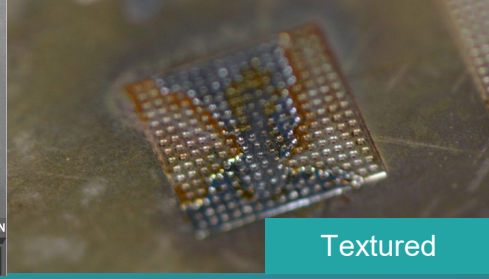
<50µm
Feature size possible with laser ablation











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