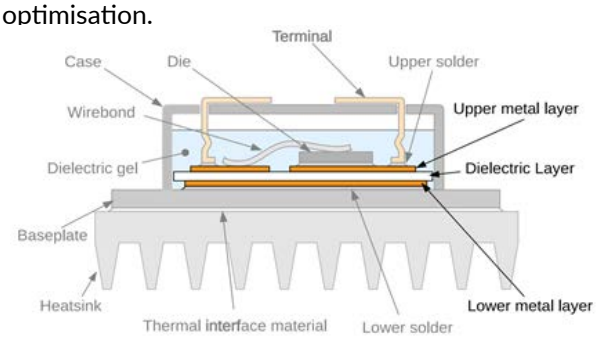
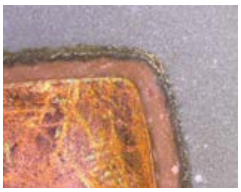
Metallised ceramic substrates for high voltage packaging

Partial discharges and breakdown voltage measurements

CONTEXT

With the development of wide-bandgap (WBG) semiconductors, a voltage rating of 10 kV and higher becomes realistic. As a consequence, it is now mandatory to propose suitable packaging. Ceramic-metal substrates such as aluminum nitride (AlN) with active metal brazed (AMB) copper are an established technology for voltages up to 3.3 kV, but they exhibit some weaknesses for higher voltages. To limit the electric field reinforcement responsible for accelerated ageing phenomena such as partial discharges (PD) or failures, new design techniques for metallised ceramic substrates may be used in order to enhance the dielectric withstand. Different layouts of substrates have been tested to compare the efficiency of the geometric arrangement. It reveals that the main step forward for high voltage substrates remains in the triple point optimisation.





APPLICATION DOMAIN

- Metallisation process
- Power electronics packaging
- Technical ceramics

ADVANTAGES

Design methodology

TRL SCALE

1 2 3 4 5 6 7 8 9

Measurement results

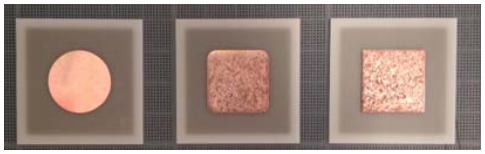
DELIVERABLES

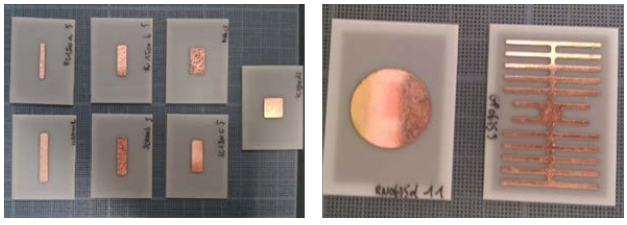
Experimental measurement report and conclusions

TECHNOLOGY DESCRIPTION

Designing a ceramic layout is often seen as a 2D exercise: the distance between each track and the corners are rounded to prevent electric field reinforcement. However, stacking the substrates can solve the track-to-track isolation issues reported in the literature. This study focuses on the metallisation corners, a set of active metal brazed (AMB) ceramic substrates coming from “Rogers Corporation” and “Kyocera” companies, are manufactured.

Partial Discharge Inception Voltage (PDIV) and breakdown voltage are measured to see if any difference is noticeable. Another set of substrates from the same supplier is tested in the same conditions allowing the decorrelation of the surface metallisation and the border length effects.





(PD) (Bkw voltage)

Measurement procedure
"Partial discharges are measured in dielectric fluid to avoid tracking discharges. Breakdown voltage is measured in dielectric fluid with a ramp of 1,5 kV/s until a breakdown occurs"