Degassing of Epoxy Resin before Curing

Microdul AG in Switzerland is a recognised expert in the miniaturisation of electronic circuits, especially for medical technology. The company uses a Memmert vacuum drying oven VO 400 for degassing epoxy resins as standard equipment in the manufacture of electronic modules, in order to remove voids before curing.

Memmert vacuum drying oven VO

Manufacturing process for electronic modules

- The example module, about 2.5 cm in diameter and only 1.4 mm thick, contains seven integrated circuits (microchips) as the main components. The electronic module is intended as a medical device for human implantation and therefore must fulfil the highest quality requirements of customers and end-users.
- The unpackaged microchips are wire-bonded directly to the circuit board of the electronic module, a particularly space saving assembly technique.
- In order to protect the microchips an epoxy resin seal is dispensed over them, which completely shields the microchips and bond wires from influences of its surroundings, such as humidity and mechanical damage.
- However during this process small bubbles or voids may form in the epoxy resin, which represent inhomogeneities in the bond-wire region. Due to variations in the coefficients of thermal expansion, the exposed bond-wires inside the epoxy resin could be deformed. As a consequence, impaired bond-wires, short circuits or even torn bond-wires could result (Fig. 1).
- To eliminate the voids, degassing of the the epoxy resin is necessary. Therefore the electronic modules

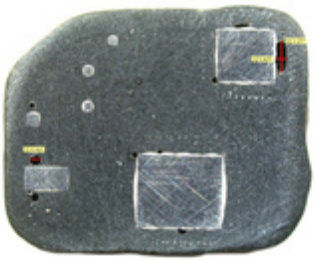

Fig. 1: Polish through the epoxy resin and the seven integrated circuits; after curing the epoxy resin without treatment in the vacuum drying oven 10 big voids are visible

Fig. 2: Polish through the epoxy resin and the seven integrated circuits; curing of the epoxy resin after degassing in the vacuum drying oven results in a void-free structure; the cross-sections of the wire-bonds are well visible as small metallic dots in the epoxy resin

are subjected to a vacuum in a Memmert vacuum drying oven. The conditions are 40°C and 20mBar pressure, applied for one hour (Fig. 2). This occurs in the clean room before the curing of the epoxy resin.

- The whole process from dispensing the epoxy resin, through the treatment in the vacuum drying oven to the thermal curing step must be completed within four hours to prevent uncontrolled partial curing of the epoxy resin.

Memmert vacuum drying oven suitable for cleanroom

The Memmert vacuum drying oven VO 400 was chosen not only for its high technical performance but also because it is suitable for use in a cleanroom, which is mandatory in the manufacture of implants. The Memmert vacuum drying oven uses a membrane vacuum pump, which allows its use in the cleanroom. With this technique the pump drive is completely isolated from the pumped medium. Products from other suppliers employ piston pumps, in which, for example, traces of the oil for the piston can leak into the pumped medium.

On Microdul AG

Microdul AG, whose offices and production site are in Zurich, Switzerland, focuses on the development and manufacture of microelectronic components. The company was formed in 1991 by a management buy-out of a Philips subsidiary. In 2010 a new class ISO-7 cleanroom was opened to satisfy the growing demands of cleanroom production, especially for medical devices. The company's three main activities are electronic modules, thick-film and semiconductors.

Fig. 3: Wire-bonded die-on-die module

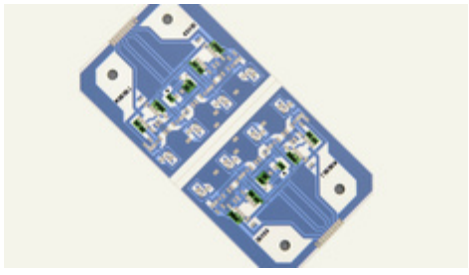

Fig. 4: Thick film substrate

Thick-film

Thick-film substrates are delivered to customers doing their own assembly or as part of an electronic module. The technology offers laser-trimmed thick film resistors and first class reliability under extreme operating conditions (Fig. 4). Popular applications are pressure sensors and complex multi-chip modules since the coefficient of thermal expansion of the ceramic base material is close to the one of

microchips. In addition to conventional thick-film, Microdul also produces copper thick-film and thick-film on steel.

Semiconductors

In the semiconductors field, Microdul works on both mixed-signal and analogue integrated circuits (ICs). Microdul is one of the few companies worldwide which offer CMOS mixed-signal arrays (Fig. 5). The company produces standard ICs as well as customer specific microchips. Extensive expertise is available in the fields of timing, temperature-measurement and sensor signal conditioning. The available CMOS technology is ideally suited to emerging trends such as capacitive sensing and energy harvesting.

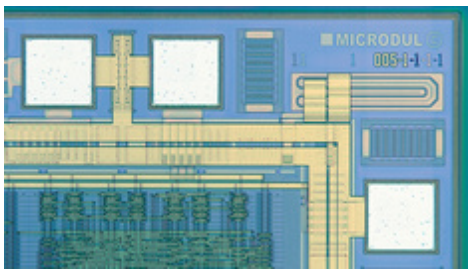

Fig. 5: Corner of a Microdul integrated circuit

Special thanks to Microdul AG, especially Dr. Kurt Mühlemann, for providing this application report.
www.microdul.com

An overview of focus topics

- Epoxy resin
- Degassing epoxy resin
- Vacuum drying oven
- Curing electronic modules
- Integrated circuits
- Cleanroom

Picture credit: © Microdul AG

Titanium powder in medical technology

Run times of more than 12 hours a day demand a lot from the vacuum drying oven at the GfE Metalle und Materialien production facilities for titanium powder.

more information

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