MASTERBOND®
CASE STUDY

EP21LVMed Used as a Biocompatible Sealant for a Wireless Optogenetic Microsystem

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Overview of EP21LVMed

EP21LVMed is a two-component epoxy formulation that can bond a wide variety of substrates and is serviceable over a wide temperature range. It passes both the USP Class VI biocompatibility requirements as well as the ISO 10993-5 cytotoxicity specifications, making it suitable for applications where biocompatibility is necessary. One such application is its use as a sealant for the hermetic packaging of biocompatible devices, such as the wireless neural interface microsystem described below.

Application

Researchers at Michigan State and Georgia Tech have developed an implantable, wirelessly-powered/controlled LED array that can modulate the activity of mouse neurons by using light. Previous approaches used surface light delivery systems, but these did not provide a sufficient light penetration depth into the brain. The reported micro-LED array provided deeper light penetration after implantation and contained microelectrodes that wirelessly recorded changes in the neural activity of mice upon illumination by the LED array.

Key Parameters and Requirements

The researchers used standard MEMS fabrication techniques to obtain their wireless micro-LED array, which precisely delivered light to the target neurons. A major concern of this approach was to ensure its biocompatibility after implantation. To ensure this, once all components of the device were assembled, the researchers applied a thick layer (200–500 µm) of biocompatible EP21LVMed, which was then wrapped in Parylene-C. Master Bond's recommended curing schedule for EP21LVMed is an overnight cure at room temperature, followed by around 2–3 hours at 150–200°F.

Results

The array's outputs, such as stimulation frequency and pulse period/width, could be controlled wirelessly via computer, and it could be wirelessly powered via an inductive link. Upon applying an appropriate voltage, the LEDs provided sufficient irradiance to evoke neural responses and showed reliable modulation over 100 repeated *in vivo* trials.

Accelerated aging tests conducted in NaCl solution at 75°C showed that the EP21LVMed/Parylene-C packaging was stable and prevented electrical failure after device implantation. No major performance degradation was observed after 14 days. The researchers extrapolated these accelerated ageing results and suggested that the device could remain stable for up to 3.5 years at body temperature (37°C). This study demonstrated the feasibility of using a wirelessly-powered optical device to stimulate and record neural activity using an LED optrode array for *in vivo* optogenetic applications. EP21LVMed played a key role in the biocompatible, hermetically-sealed packing of this device and helped prevent electrical failure during long-term implantation.

References

Kwon, K. Y.; Lee, H. M.; Ghovanloo, M.; Weber, A.; Li, W. Design, Fabrication, and Packaging of an Integrated, Wirelessly-Powered Optrode Array for Optogenetics Application. *Front. Syst. Neurosci.* 2015, 9 (MAY), 1–12. https://doi.org/10.3389/FNSYS.2015.00069.