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EMBEDDING SMALL AND THIN ELECTRONICS INTO FLEXIBLE IMPLANTS

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Electronic components in the form of application-specific integrated circuits (ASICs) establishing the communication between the body and the implant, such as stimulation and recording, have, nowadays, become essential elements for current and future generations of implantable devices, as medicine is looking into substituting its traditional pharmaceuticals with electroceuticals, or bioelectronic medicines.[1]

Protection of implant components inside the body is a mandatory important step to ensure longevity and reliable performance of the device. The package of the implant should act as a bidirectional diffusion barrier protecting the electronics of the device from body liquids, and also preventing diffusion of toxic materials from the implant towards the tissue, at the same time matching tissue mechanical properties.

Current implants do not completely fulfil the desired properties mentioned above, facing different kinds of challenges. For soft implants made on polymer substrates and using polymer as an outer layer, encapsulation challenges happen at the interfaces of the polymer with other components inside the implant, as water ingress and condensation, which leads to electronics failure, happens there. In this work, an embedding process developed at Fraunhofer IZM[2] and used in semiconductor packaging field for chip encapsulation is being tailored to be used for protecting implantable ASICs. Such a method, which is based on a lamination process using heat and pressure, will reduce the critical interface points at the polymer-to-polymer contact due to the merging of polyurethane layers during the embedding process. Furthermore, flip chip bonding will allow to avoid long interconnects, as the interconnection bumps can be made on the whole chip area and redistributed on the polymer substrate.

In the proposed process, biocompatible polyurethane is employed and gold metallisation is used to form electrodes and connect them to extremely thin (10-30 μm) ASICs. The developed embedding process technology will ensure homogeneous distribution of mechanical stresses and longer reliability, resulting uninterrupted long-term use of smart implants (Fig.1).

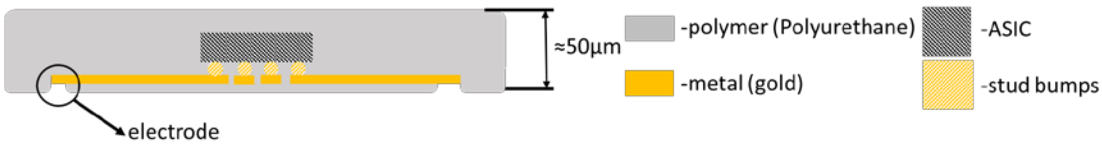

Fig.1. Schematic representation of embedded implant.

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