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Pak, Anna; Serdijn, Wouter; Giagka, Vasiliki

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EMBEDDING SMALL ELECTRONIC COMPONENTS INTO TINY FLEXIBLE IMPLANTS

Anna Pak[1,2], Wouter A. Serdijn[1], and Vasiliki Giagka[1,2]

[1]Bioelectronics Section, Department of Microelectronics, Faculty of Electrical Engineering, Mathematics and Computer Science, Delft University of Technology

Mekelweg 4, 2628 CD, Delft, The Netherlands

[2]Technologies for Bioelectronics Group, Department of System Integration and Interconnection Technologies, Fraunhofer Institute for Reliability and Microintegration IZM

Gustav-Meyer-Allee 25, 13355, Berlin, Germany

e-mail: A.Pak@tudelft.nl

ABSTRACT

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 the implant's outer layer should match the tissue's mechanical properties in order not to cause scar growth around the implant or damage the body.

Current implants do not completely fulfill the desired properties mentioned above, either lacking hermeticity or softness.

In this work, an embedding process developed at Fraunhofer IZM [2] and used in the semiconductor packaging field for chip encapsulation is proposed to be modified and used for protecting implantable ASICs. Such a method will have a number of advantages, such as miniaturization, in comparison with conventional titanium case packaging. Furthermore, embedding allows to avoid long interconnects, which can be a crucial problem for the device implanted inside a constantly moving body. The other advantage is that the geometry of these interconnects can be well controlled, and the amount of contact pads can be higher than in widely used wire bonding technology, because the distribution of solder bumps during embedding can take place on the whole chip area.

In the proposed process, biocompatible polymer materials, such as ParyleneC and Polyurethane, together with thin glass films will be employed to provide the implant with the required hermeticity and at the same time flexibility. The developed embedding process technology will ensure homogeneous distribution of mechanical stresses, resulting in high reliability for uninterrupted long-term use of smart implants.

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