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Abstract

Steps towards printed electronics on silicone rubber for active implantable medical devices (AIMD)

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AIMD are implants that deliver (electrical) power into the human body e.g. for neural or muscular stimulation. As state of today, electrodes, wires and electronics are assembled in manufactures of platinum-iridium based platelets and leads (25 µm diam.) encased by the gold standard silicone rubber and using feedthroughs to titanium electronic housings. This ensures lifetimes of >50 years implantation which is especially needed for 6-month-old children receiving cochlear implants for lifelong use.

In the course of the current trend in medical technology towards personalisation, there is a desire for a more flexible electrode design and often a higher number of electrodes and flexible. This should be possible with additive manufacturing methods and novel solutions that are bringing the electrodes closer to their target neural cells [1]. However, the printing of silicone for unrestricted use (chronic implantation) is still the rare case, has voxel restrictions and the printing of conductive paths and electrodes on flexible silicone is also challenging.

We have solved the 3D printing of unrestricted silicone by means of infrared laser vulcanisation [2], but are aware of the limits of the attainable resolution. The problem with printing and available conductor materials is that there is hardly any material that provides mechanical-electrical compliance with silicone and, more importantly, suitable biocompatibility. We provide an overview of the available materials and the exemplary results we have achieved, e.g. [3]. If necessary, hybrid processes can be used here, which do not fulfil the 'pure philosophy' of additive manufacturing, but can be just as effective. For medical applications, however, everything that can pave the way for clinical approval of new, patient-specific solutions can be considered.

AUTHOR'S STATEMENT

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