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TOWARDS A SEMI-FLEXIBLE PARYLENE-BASED PLATFORM TECHNOLOGY FOR ACTIVE IMPLANTABLE MEDICAL DEVICES

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ABSTRACT

Active implantable medical devices have been developed for diagnosis, monitoring and treatment of large variety of neural disorders. Since the mechanical properties of these devices need to be matched to the tissue, soft materials, such as polymers are often preferred as a substrate [1]. Parylene is a good candidate, as it is highly biocompatible and it can be deposited/etched using standard Integrated Circuit (IC) fabrication methods/processes. Further, the implantable devices should be smart, a goal that can be accomplished by including ICs. These ICs, often come in the form of additional pre-packaged components that are assembled on the implant in a heterogenous process. Such a hybrid integration, however, does not allow for size minimization, which is so critical in these applications, as otherwise the implants can cause severe damage to the tissue. On the other hand, it is essential that all components are properly packaged to prevent early failure due to moisture penetration [2].

In this work we use a previously developed semi-flexible platform technology based on a Parylene substrate and Pt metallization, which allows integration of electronic components with a flexible substrate in a monolithic process. We use an IC fabrication-based platform that allows for the fabrication of several rigid regions including Application-Specific Integrated Circuits (ASICs) and other components connected to each other by means of flexible interconnects. We aim to add more functionality to this technology and thereby extend it to a platform for a variety of medical applications. An example of such functionality is integrating Light Emitting Diodes (LEDs) for optogenetic stimulation or integrating Capacitive Micromachined Ultrasound Transducers (CMUTs) for ultrasound stimulation or ultrasound wireless power transfer. Since the long-term reliability is critical for implantable devices, we intend to reinforce our implant with an extra Polydimethylsiloxane (PDMS) encapsulation layer that relies on the low viscosity of the uncured rubber to flow in every detail of the surface to prevent void formation [3]. Therefore, this work also focuses on enhancing the adhesion of PDMS to Parylene, as it must remain strong for the required lifetime of the device.

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