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# TOWARDS AN ACTIVE GRAPHENE-PDMS IMPLANT

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## ABSTRACT

Neural interface in the form of microelectrodes are used to monitor and treat spinal cord injury and other neurological disorders by the means of recording and stimulation. Despite of the apparent result of these electrical interventions, understanding of the mechanism behind neural stimulation is still inadequate. The use of optical monitoring during implantation is limited due to the use of opaque electrode partially blocking the implantation site. While the use of transparent conductor for electrode is not uncommon in general electronics where indium tin oxide (ITO) is widely used for displays, however ITO is not suitable for implantation due to its brittle nature[1].

An alternative material to fabricate transparent electrodes is graphene, a single layer of carbon atom forming $sp^2$ hybridization. Its high charge mobility, flexibility, mechanical strength and optical transparency make it suitable for various flexible electronics applications including implantable microelectrode arrays. In biomedical fields, graphene has shown potential application as biosensor, stimulation and recording electrode[2].

Although fabrication of graphene microelectrodes has been previously shown[3], graphene had to be transferred manually for each individual implant. The high temperature needed during graphene deposition makes device fabrication directly on the flexible material impossible. Instead, the fabrication process relies on a transferring process of graphene layer from growing medium with high thermal budget to another desired substrate. Manual transfer process of graphene is a skill-dependant process with low scalability.

In this work, a method of fabricating encapsulated graphene electrodes in polydimethylsiloxane (PDMS) with a controlled wafer-scale graphene transfer is proposed. Graphene transfer is done by wafer-assisted PDMS-PDMS bonding to minimalize operator dependency. The novel use of PDMS as encapsulation material for graphene electrode is due to its biocompatibility, flexibility and optical transmittance.

Difference in material characteristics, such as the thermal expansion coefficient has become one of the challenges during fabrication process. Despite of these challenges, the prospect of transparent implant has been shown in preliminary testing on optical transmittance of graphene layer on PDMS with up to 77% transmittance in the visible light spectrum. While full characterization of the device is still in progress, further results will be reported during the conference.

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