Flexible, graphene-based active implant for spinal cord stimulation In rodents

Velea, A.; Vollebregt, S.; Giagka, Vasiliki

Publication date
2019

Document Version
Accepted author manuscript

Citation (APA)
Velea, A., Vollebregt, S., & Giagka, V. (2019). *Flexible, graphene-based active implant for spinal cord stimulation In rodents*. Abstract from ProRISC 2019, Delft, Netherlands.

FLEXIBLE, GRAPHENE-BASED ACTIVE IMPLANT FOR SPINAL CORD STIMULATION IN RODENTS

Andrada Iulia Velea[1,2], Sten Vollebregt[2], Vasiliki Giagka[1,3]

[1]Bioelectronics Section and [2]Electronic Components, Technology and Materials Section, Department of Microelectronics, Delft University of Technology, Mekelweg 4, 2628 CD, Delft, The Netherlands

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

E-mail: A.I.Velea@student.tudelft.nl

Abstract

The most important symptoms of spinal cord injuries (SCIs) are partial or complete loss of sensory and/or motor functions caused by the disruption of the neural pathway between the brain and the extremities of the body. Recent studies have shown that epidural spinal cord stimulation (ESCS) can promote locomotor recovery in patients affected by SCIs, thus becoming one of the most promising means of treatment for the lesion.

Devices currently available on the market, consist of active components, enclosed in a hard case and connected via leads to the electrodes that form the interface between the stimulator and the biological tissue. The presence of leads along the spine, may be an important cause of failure for the device. Moreover, the overall stiffness of the stimulator does not resemble best the anatomical structure of the human body. Flexibility and optical monitoring of the biological tissue during implantation and stimulation are very important aspects and both can be improved with a proper choice of materials.

The goal of this work is to develop a compact, active, transparent and flexible spinal cord stimulator that could be implanted at the site of stimulation.

To provide high flexibility, soft encapsulation, using polydimethylsiloxane (PDMS) has been used. To ensure transparency but also mechanical stability of the electrodes and tracks, graphene has been chosen as a replacement for the conventional metals. Integrating active components, in the form of application specific integrated circuits (ASICs), on a graphene-based substrate, constitutes the biggest challenge. To this end, flip chip bonding techniques using a metal layer as an interface between graphene and the chip's stud-bumped pads, are being investigated.

Preliminary measurements after bonding have shown resistance values in the range of kΩ, thus taking the project one step closer to achieving the desired goal.