Projects at the EPFL Center of MicroNanoTechnology

MICROELECTRODE ARRAY BIOCHIPS FOR THE ELECTRICAL MONITORING OF 3D ENGINEERED HUMAN BRAIN TISSUES

M. Heuschkel, L. Gomez Baisac, C. Loussert-Fonta, L. Stoppini and A. Roux
Tissue Engineering Laboratory, HEPIA, HES-SO, Geneva

hepia
Haute école du paysage, d'ingénierie et d'architecture de Genève

Project objective:

The objective of this project was the development of a screening and testing platform adapted to the electrophysiological monitoring of 3D neural tissues derived from reprogrammed human stem cells (iPSC) at air-liquid interface. The tissue is interfaced using a Micro-Electrode Array biochips consisting of a 10% porous polyimide membrane (thickness: 8 µm) incorporating an array of 32 recording sites coated with a layer of black platinum, which is mounted on a printed circuit board allowing connection to external signal amplification and data acquisition. A fluidic channel located below the tissue allows the perfusion of nutrients as well as test compounds.

Figure 1: Realised biochip composed of a porous polyimide membrane comprising 4 recording areas with 8 recording sites at each.

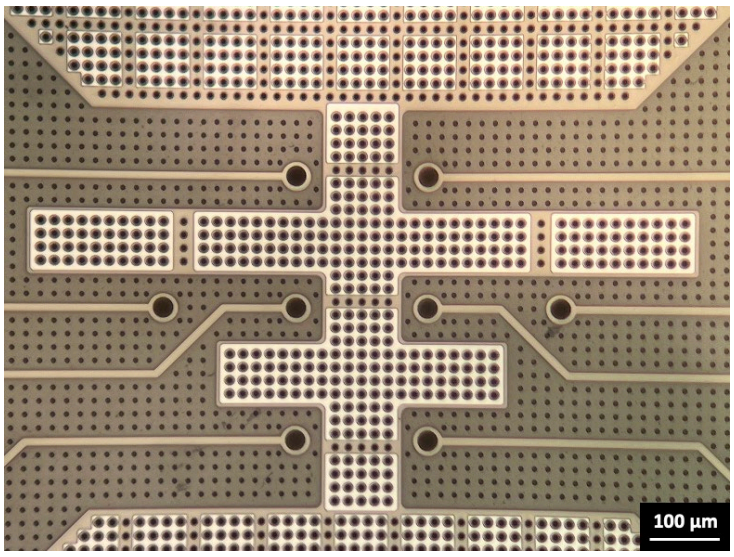

Figure 2: Magnified view of a recording area composed of 8 micro-electrodes coated with porous platinum black (black circles).

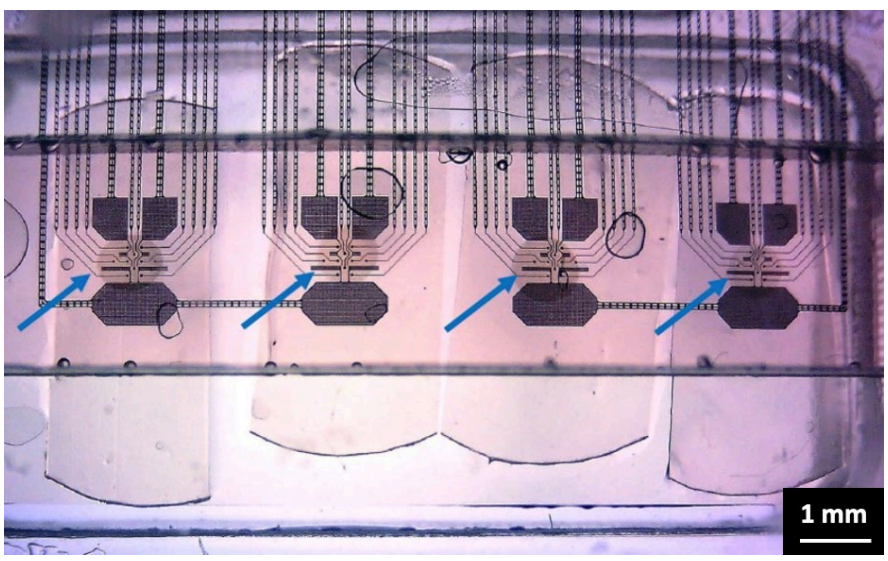

Figure 3: The membrane covers a fluidic channel allowing nutrients to reach 4 neural tissues at air-liquid interface (arrows) through its porosity.

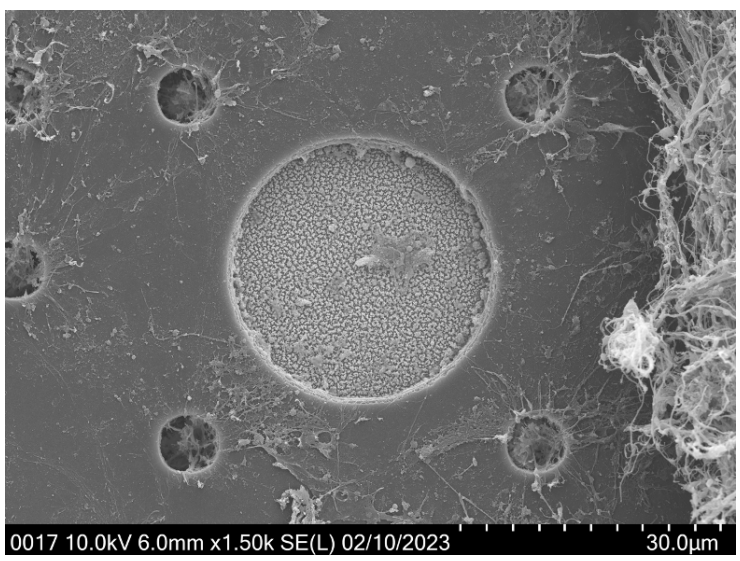

Figure 4: SEM of an electrode showing the porous structure of the platinum black coating. Neural tissue is also present at right.

Techniques employed: Sputtering: SPIDER600; Dry etching: IBE and SPTS-APS;
Photolithography: Polyimide PI-2611, AZ 10XT-20 and AZ ECI 3027

Publications:

[1] R Wertenbroek, et al., *SpikeOnChip: A Custom Embedded Platform for Neuronal Activity Recording and Analysis*, IEEE Trans Biomed Circuits Syst., **15**:4, 743-755 (2021)

[2] C Loussert-Fonta, et al., *Opening the black box of traumatic brain injury: a holistic approach combining human 3D neural tissue and an in vitro traumatic brain injury induction device*, Front. Neurosci. **17**:1189615 (2023)

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