Towards the Development of Transparent Graphene Micro Electrode Arrays

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Introduction and Motivation

Microelectrode arrays (MEAs) [1] are widely used to record the cellular activity. The standard electrode materials in use are platinum, gold and titanium nitride. The entry of carbon based materials in the field of MEAs is only a decade old. Graphene and carbon nanotubes (CNTs) are extensively researched carbon based materials. The application of graphene in optogenetics [2] and calcium imaging [3] is reported in the year 2014. The main advantage of graphene is transparency. Here, we present the fabrication of graphene-based MEAs comprising gold interconnects terminated by graphene electrodes, where an optimal balance between transparency, size of the electrode and impedance is aimed for.

Electrical Characterization

MEA device

Micro Electrode Array (MEA)

Resulting in Au
graphene electrodes.

Electrical Characterization

Figure 8: Impedance spectra of 9 graphene electrodes in the well seen in figure 6. The impedance is measured against the internal reference electrode. Measurement is performed with PBS as electrolyte. The impedance value is evaluated at the frequency of 1 kHz.

Results and Outlook

- Reproducible and reliable graphene growth process is established following chemical vapour deposition with Cu as catalyst and methane as carbon source as seen in figure 4.
- Largely monolayer graphene of size 2.5 cm x 2.5 cm is successfully produced and transferred to MEA conduction lines as seen in figure 5.
- Graphene is structured by photolithography (figure 5) and the presence and quality of graphene is checked by SEM imaging and Raman mapping as seen in figure 7. The presence of largely monolayer graphene is confirmed by the Raman spectrum where G and 2D peaks are clearly visible.
- Graphene based transparent MEA is produced and impedance is measured.
- Experiments to test the applicability of the fabricated MEAs for optogenetic measurements and for calcium imaging are planned.

References / Acknowledgements


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