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Titanium Nitride Nanotube Electrode

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Electrical and Computer Engineering

Opportunity and Significance

This electrode presents corrosion-resistant and high capacity implantable TiN nanotube electrode to work as a neural probe. Smaller electrode size allows for reduced tissue damage while the nanopore morphology of the TiN gives a larger surface area and stability to the electrode.

Technical Objectives

The objectives of this project are based around the significance of building an electrode that offers improved biocompatibility, reduced tissue damage, reduced cost, and increased usability over time.

Related Work and State of Practice

Currently, we are moving forward with the electrode fabrication process for selective dopamine detection, neural action potential detection, and muscle action potential detection.

Acknowledgments and appreciation to ROEU for funding

Figure 1

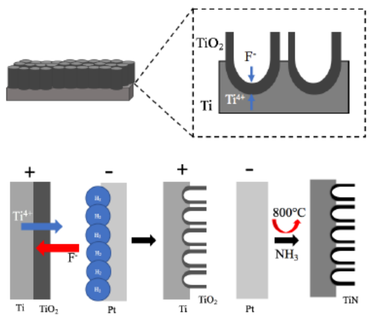
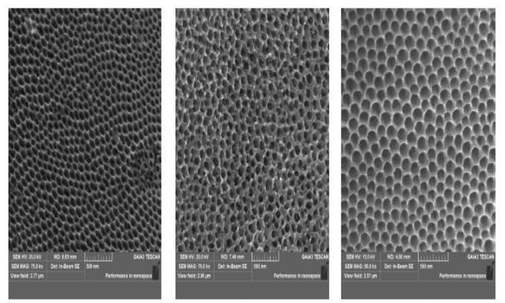


Figure 2



Technical Approach, Accomplishments and Results

The fabrication process of the electrode is a double anodization technique using Ti wire (diameter 0.5 mm) sealed in glass with exposed tip as working electrode and Pt foil wrapped into a cylindrical shape as a counter electrode. This forms the uniform TiO2 nanotube morphology on the exposed tip. The wire is then nitridated at increasing temperatures to 800 deg C which finalizes the TiN electrode fabrication (Fig. 1).

Pore size of the nanotubes have a linear relationship with the voltage applied, experiments showcased pore size growth at 30V, 45V and 60V (Fig. 2).

The result of experiments have shown that the fabricated TiN electrode presents a stable capacitive charge injection whereas commercial electrodes use faradic or pseudocapacitive charge transfer. The TiN electrode maintained morphology after 96 hrs in PBS where tungsten electrode showed surface corrosion (Fig. 3).

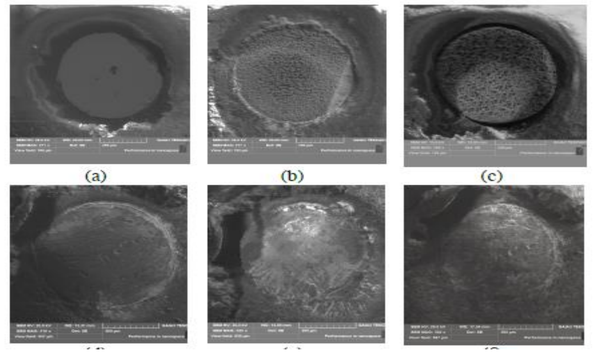
Next Steps for Development and Test

Further development involves creating a standard practice of the fabrication process. This would be needed to ensure standard results in pore morphology as well as standard testing procedures.

Commercialization Plan & Partners

At this time we are not actively working with a partner for the commercialization of the electrode. Dr. Cheng has shown interest in the possibility of commercializing the electrode once further experiments have been completed.

Figure 3



References

G. Chen, M. Cheng, M. Gatti. (2019) titanium nitride nanotubes electrodes used for chronic neural stimulation.