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NEUROSCIENCE AND PHYSIOLOGY SEMINAR SERIES

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"Characterizing TiN Neural Ultramicroelectrodes Using Electrical Impedance Spectroscopy for Electrical Stimulation Applications."

Electrical stimulation via intracranial microelectrodes is an effective approach for extracting neural responses and has many applications, including in brain-machine interfaces. High-fidelity stimulation can be achieved through miniaturized micro-electrodes that interface with individual cells. To enhance stimulation performance without exceeding electrochemical safety limits, low-impedance electrodes that can also store high charge capacity are required. However, these materials may produce residual voltage during and after the stimulation period. While poorly studied, increasing residual voltages may lead to chronic damage to both the surrounding tissue and the electrodes. In this work, we employed Electrochemical impedance spectroscopy (EIS) to characterize the electrode-tissue interface by applying small sinusoidal perturbations at a range of frequencies in order to construct the electrode's impedance spectra. An Electrical lumped circuit model is then fitted to the verified EIS data to approximate the electrochemical interface on the electrode surface. Our aim is to build a nonlinear model of Titanium nitride (TiN) electrical stimulation performance using non-invasive EIS probing. This work, when completed, is significant as it aims to provide a simple technique for using EIS data to assess TiN electrode stimulation performance.

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