# Chronic Stability of Ruthenium Oxide Electrodes in Rat Motor Cortex


**Mrigank Maharana**[1], Mahasty Khajehzadeh[1], Justin R. Abbott[1], Elanor N. Jeakle[1], Thomas J. Smith[2], Joseph J. Pancrazio[1], Stuart F. Cogan[1]

[1] Department of Bioengineering, The University of Texas at Dallas
[2] School of Behavioral and Brain Sciences, The University of Texas Dallas


## INTRODUCTION

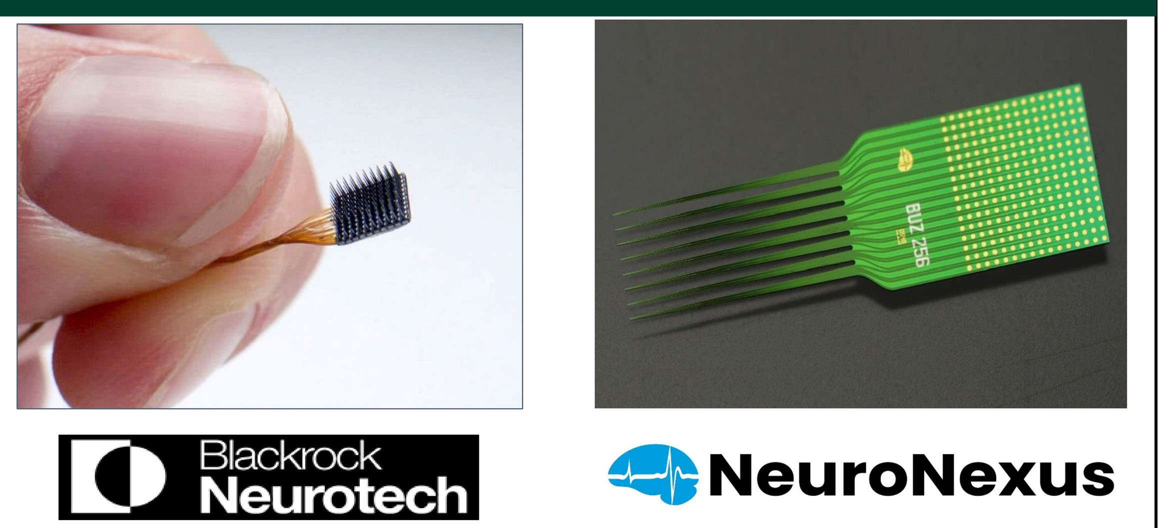



Figure 1. Industry Examples of Microelectrode Arrays.

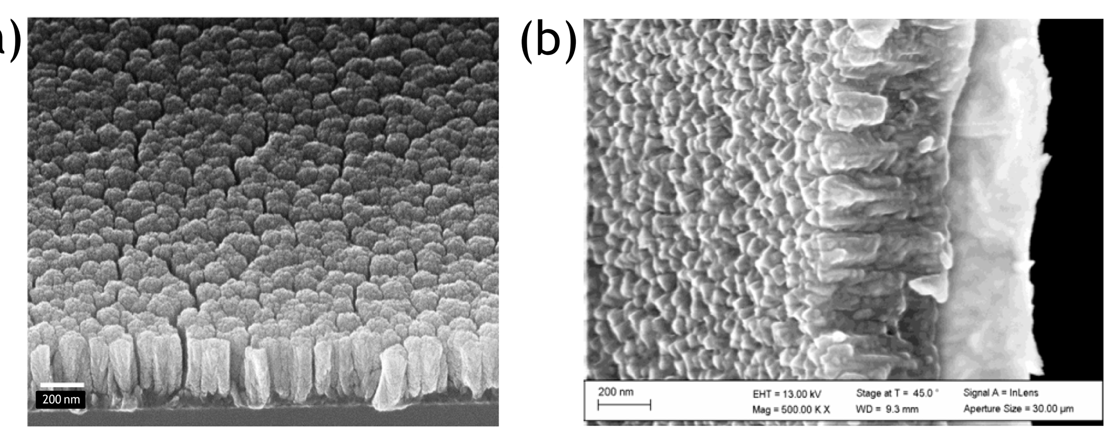


Figure 2. Cross-sectional Scanning Electron Microscopy of (a) Ruthenium Oxide (RuOx) and (b) Titanium Nitride (TiN) [1, 2].

## OBJECTIVE

This study evaluates the chronic stability and performance of microelectrode arrays (MEAs) with alternative, cost-effective Microelectrode coatings by assessing impedance (Z) and charge storage capacity (CSC). Validated with recording neural activity.

## APPROACH

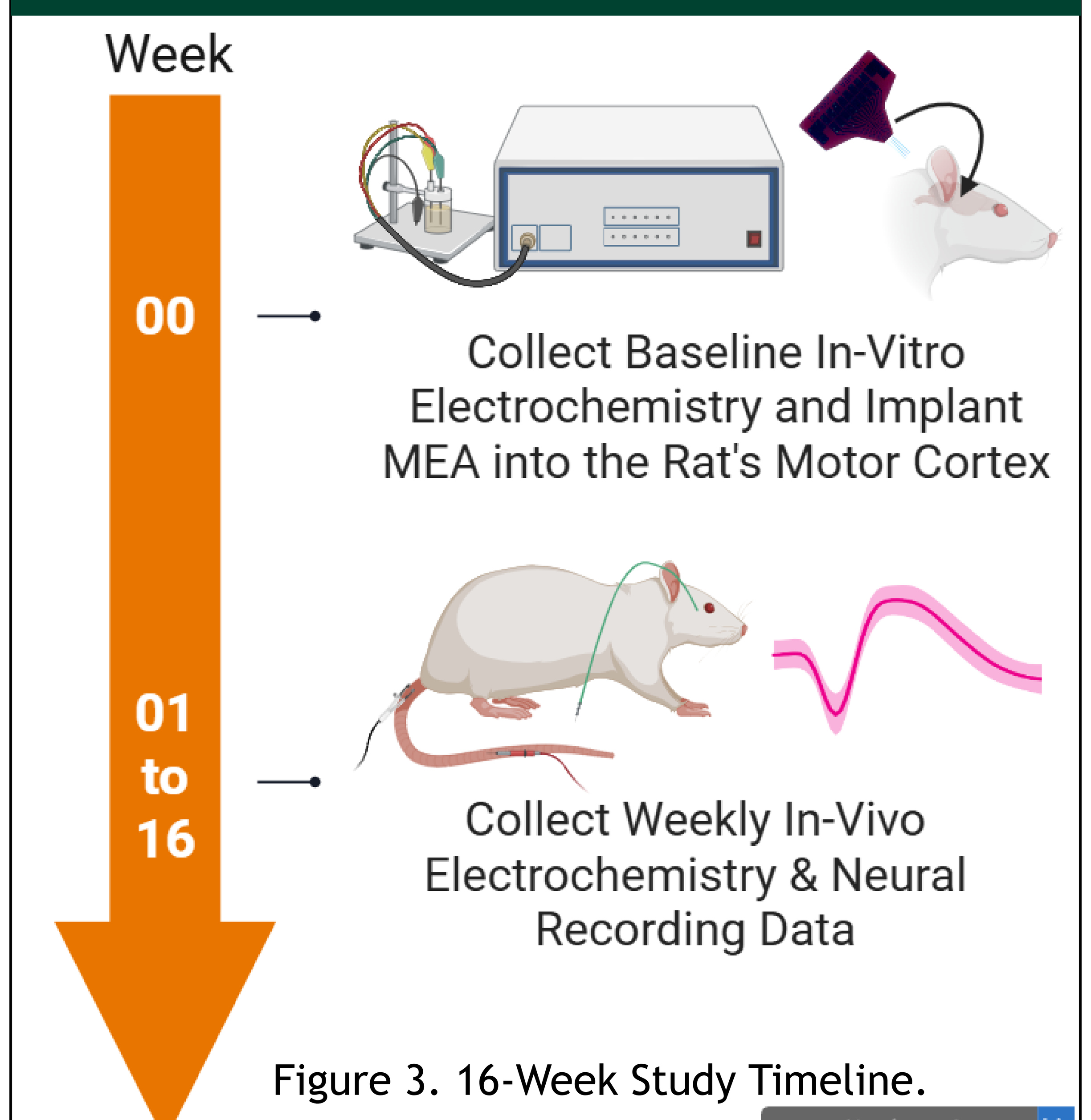



Figure 3. 16-Week Study Timeline.

## METHODS

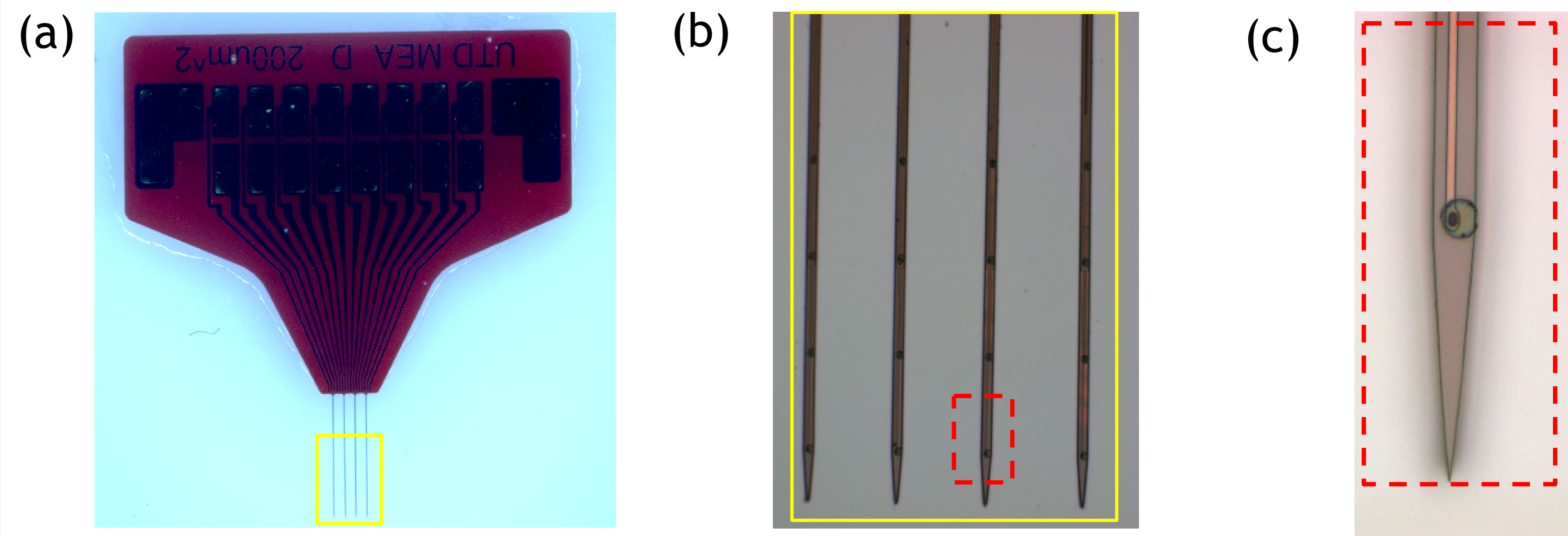



Figure 4. 4-shank Amorphous Silicon Carbide (a-SiC) Ultra Microelectrode Array (UMEA). (a) Device. (b) Penetrating Shanks. (c) Electrode Site.

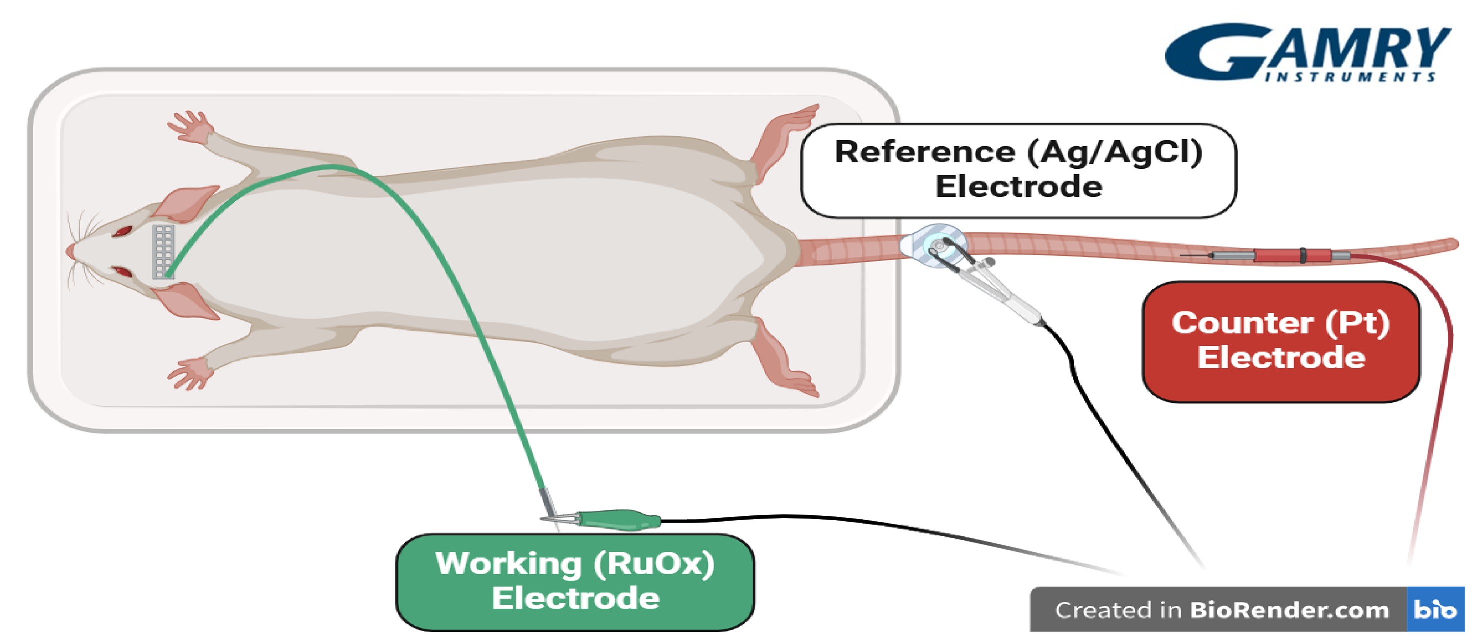



Figure 5. In-Vivo Data Collection Rig.

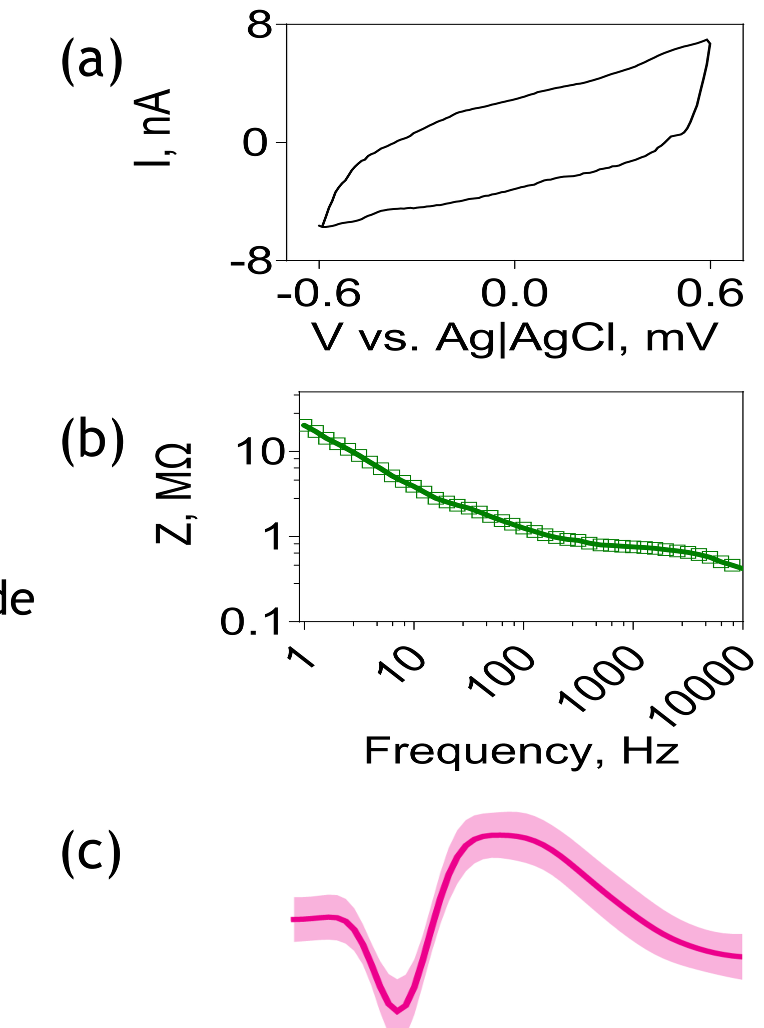
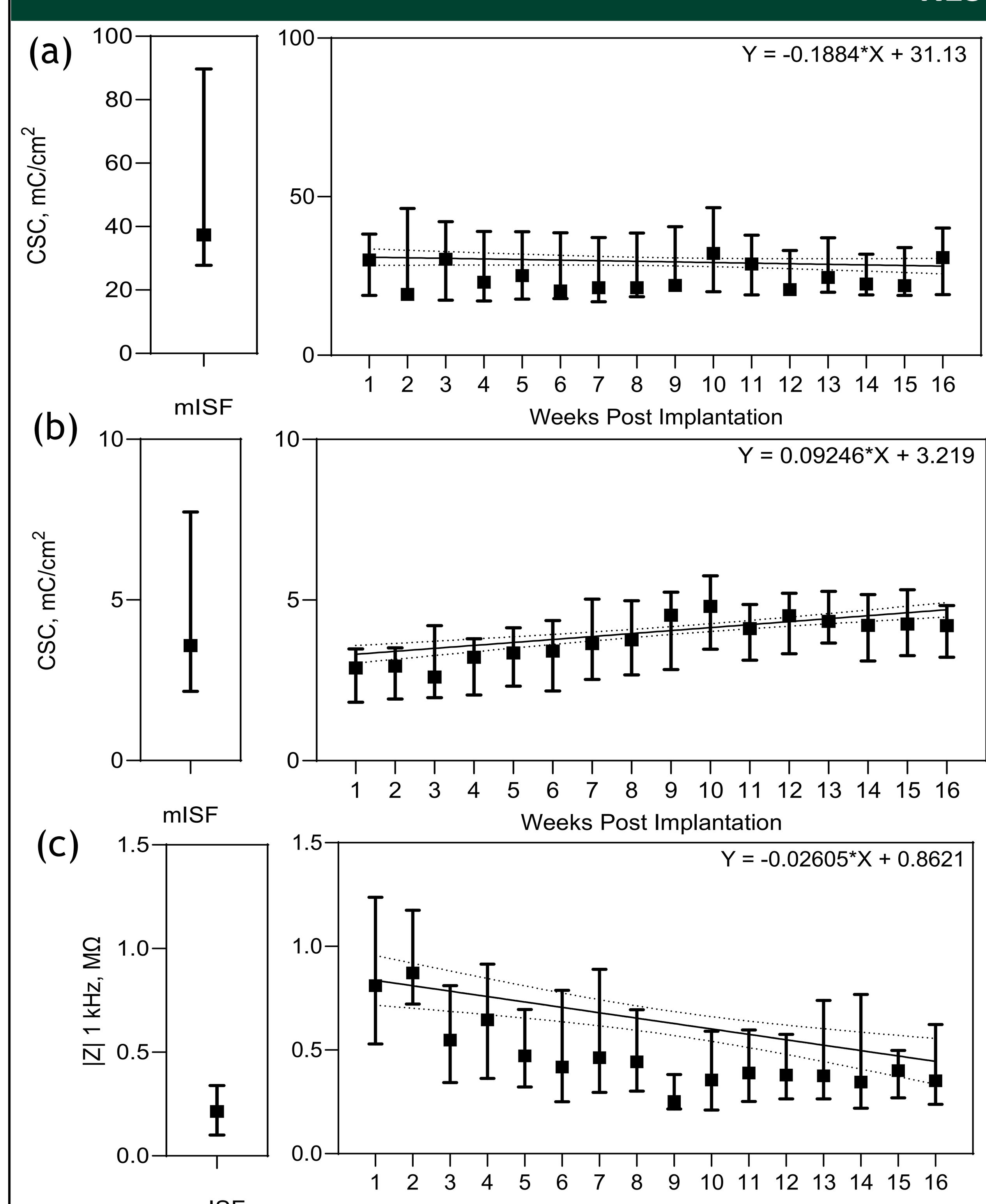



Figure 6. (a) Representation of Cyclic Voltammogram. (b) Representation of Electrochemical Impedance Spectroscopy. (c) Representation of extracellular action potential during neural recording.

## RESULTS



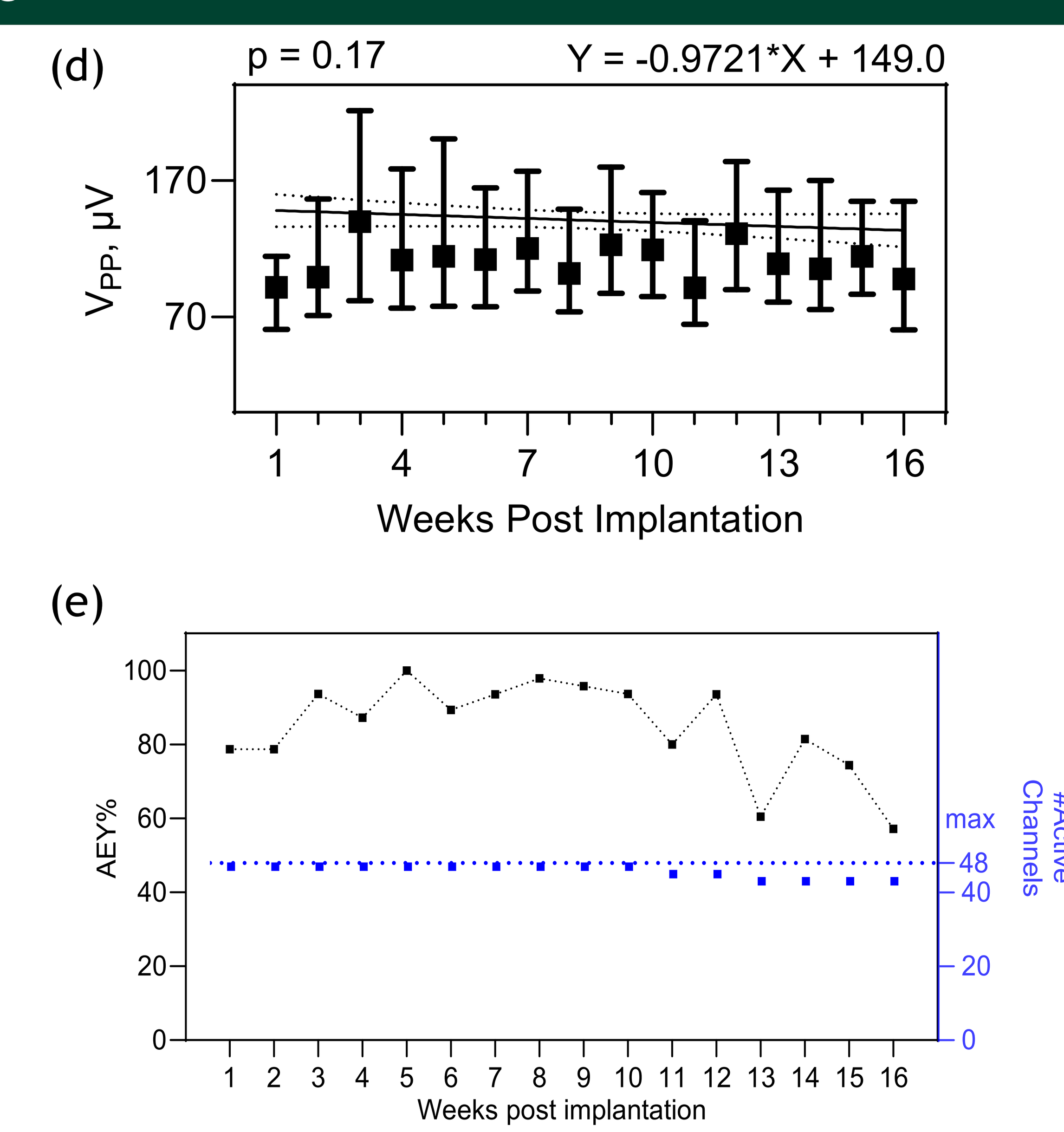




Figure 7. Charge Storage Capacity at (a) 50 mV/s and (b) 50k mV/s. (c) Electrochemical Impedance Spectroscopy at 1 kHz. (d) Neural Recording Peak-to-Peak voltage. (e) Active Electrode Yield Percentage.

## CONCLUSIONS

Ruthenium Oxide (RuOx) Coatings on amorphous silicon carbide (a-SiC) microelectrode arrays demonstrate a stable electrochemical performance over 16 weeks.

These results suggest RuOx-coated a-SiC electrodes are a promising platform for chronic neural recording and stimulation.

## REFRENCES


[1] B. Chakraborty, A. Joshi-Imre, and S. F. Cogan, "Charge injection characteristics of sputtered ruthenium oxide electrodes for neural stimulation and recording," *J. Biomed. Mater. Res. B Appl. Biomater.*, vol. 110, no. 1, pp. 229-238, Jan. 2022, doi: 10.1002/jbm.b.34906.

[2] J. R. Abbott, A. Joshi-Imre, and S. F. Cogan, "In vitro electrochemical properties of titanium nitride neural stimulating and recording electrodes as a function of film thickness and voltage biasing," in *Proc. 43rd Annu. Int. Conf. IEEE Eng. Med. Biol. Soc. (EMBC)*, Mexico, 2021, pp. 6647-6650, doi: 10.1109/EMBC46164.2021.9630715.


## ACKNOWLEDGMENTS


This work was supported by the National Institutes of Health/National Institute of Neurological Disorders and Stroke under Grant No. R01NS104344.

NIH National Institute of Neurological Disorders and Stroke


## CONTACT


Faculty Advisor: Dr. Stuart F. Cogan
Graduate Mentor: Mahasty Khajehzadeh
Applicant: Mrigank "Mk" Maharana


**Questions/Feedback/Contact**