

Neural Prosthesis Seminar

"Limitations and Opportunities with Neural Stimulation Electrodes"

April 16, 2010 • 8:30 AM

Biomedical Research Building • BRB 105

Case Western Reserve University



Stuart F. Cogan, ScD

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Vice-President, Director of Advanced Materials Research
EIC Laboratories

Abstract:

The development of electrodes and multielectrode arrays for neural stimulation has been ongoing for several decades. Attention has focused on low impedance electrode materials capable of electrochemically safe charge injection. Parallel studies of electrical thresholds for functional responses and tissue damage have been ongoing with recent work focusing on thresholds obtained with microelectrodes that reside within or on central nervous system structures. The results from these studies are analyzed and presented in an effort to identify those factors that are most likely to limit electrode performance. Results to date suggest that stimulation with indwelling microelectrodes will have a narrow therapeutic window between functional thresholds and charge levels that are injurious to tissue. Possible mechanisms of tissue damage and approaches to selecting stimulation protocols and electrode materials that might minimize tissue damage with microelectrodes are discussed. Recent studies at EIC Laboratories on the development of redox-active coatings based on iridium oxide and the conductive polymer poly(ethylenedioxythiophene) are also presented with an emphasis on comparing in vitro electrode properties with those observed during chronic animal studies. The electrochemical processes at a stimulation electrode that are most likely affected by tissue and electrode encapsulation are identified and their relevance to chronic in vivo stability discussed.

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