NEURAL ENGINEERING SEMINAR SERIES

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Biomaterials Strategies Towards Seamless Neural Tissue-Device Interface

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ABSTRACT:

Microelectronic devices, placed in the nervous system to record and modulate neuroactivity or detect neurochemicals, present tremendous potentials for understanding neural circuits and treating neurological diseases. Currently, the performance of these devices is sub-optimum due to material limitations and undesired host tissue responses. Quantitative histology and 2-photon imaging revealed neuronal damage, inflammation and oxidative stress at the site of implants. Meanwhile material degradation is a frequent factor of device failure. We use several biomaterial strategies to minimize these failure modes. First, conducting polymer-based nanocomposites have been investigated as electrode coatings to facilitate the signal transduction between the ionically conductive tissue and the electronic device. We employ nanotechnology to improve the stability, charge injection and drug delivery capability of the conducting polymers to meet the material challenges. Secondly, materials and devices that mimic the mechanical properties of the neural tissue have been developed and shown to significantly reduce the chronic inflammation. Thirdly biomimetic surface modifications and drug delivery have been applied to actively modulate the cellular responses. These bioactive approaches demonstrated significant effects in improving neural interface performance. The ultimate solution to a seamless device/tissue interface may be a combinatorial approach that takes advantage of multiple strategies discussed above and beyond.

BIOGRAPHY:

Dr. Tracy Cui is the William Kepler Whiteford Professor of Bioengineering at the University of Pittsburgh. She earned her PhD in Macromolecular Science and Engineering from the University of Michigan. She works in the field of neural engineering with special focuses on neural electrode-tissue interface, neural tissue engineering, drug delivery, and biosensors. She has a H index of 59 with over 11,000 citations and 6 patents. Dr. Cui has won numerous awards and recognitions, including 2023 Senior Member of National Academy of Inventor, 2017 Fellow of Royal Society of Chemistry, 2016 Fellow of American Institute of Medical and Biological Engineering, 2015 Carnegie Science Emerging Female Scientist Award, 2008 National Science Foundation Early Career Award, and 2005 Wallace Coulter Translational Research Career Award.