BIOMEDICAL ENGINEERING
Carnegie Mellon University

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10:30 – 11:30 a.m.
Posner Hall A35

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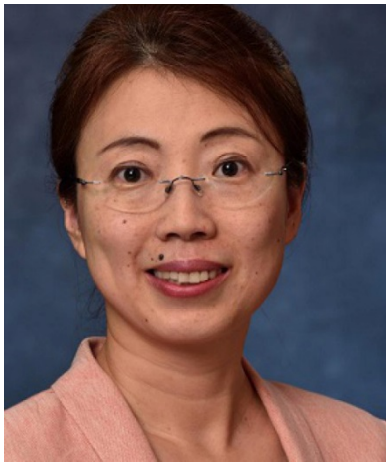

Biomimetic Strategies Towards Seamless Neural Implants/Tissue Integration

Abstract: Microelectronic devices placed in the nervous system present tremendous potentials for investigating neural circuits and treating neurological disorders. Currently, these devices often experience failures in part due to the electrical, mechanical, and biochemical, mismatch between the artificial device and neural tissue. Quantitative histology and 2 photon imaging have revealed neuronal damage and degeneration, inflammatory gliosis, blood brain barrier leakage and oxidative stress as a result of implantation. Several biomaterial strategies have been investigated to minimize the mismatches and achieve seamless and stable device-tissue interface. First, various conducting polymer based nanocomposites have been investigated as electrode coatings and facilitate the signal transduction/charge transfer between ionically conductive tissue and electrical device. Secondly, to minimize the mechanical mismatch at the device-brain tissue interface, novel soft and elastomeric electrode materials have been developed with Young's modulus approaching that of neural tissue (less than 1 MPa). Soft implants demonstrated reduced inflammatory tissue response in both CNS and PNS compared to stiff implants of similar geometry and surface chemistry. Thirdly, bioactive approaches are being developed to modulate the biological responses. One approach is to decorate the implant surface with biomolecules derived from the brain or synthetic biomolecule mimics. Surface immobilization with these bioactive molecules significantly improved neuronal health and inhibited the inflammatory tissue response around the implants. Another approach is to deliver therapeutics that control inflammation, neurodegeneration and oxidative stress. These bioactive approaches have demonstrated significant benefit in neural recording quality and longevity. The ultimate solution to a seamless device/tissue interface may be a combinatorial approach that takes advantage of multiple biomimetic strategies discussed above and beyond.