Nano- and micro-structured biosensors on stiff and flexible substrates for implantable and wearable biomarker sensing

Anne Milasincic Andrews
Departments of Chemistry & Biochemistry and Psychiatry & Biobehavioral Health, Semel Institute for Neuroscience and Human Behavior, Hatos Center for Neuropharmacology, and California NanoSystems Institute, University of California, Los Angeles, USA

We employ field-effect transistor sensors functionalized with ssDNA receptors for small molecule sensing in high-salt physiological environments. We have developed fabrication methods for hard and soft materials to produce wearable and implantable devices bearing FET sensors. We fabricated multi-FET probes on Si in 150 µm x 150 µm and 50 µm x 50 µm formats. Both formats are stiff enough for tissue implantation, while the smaller format possesses flexibility. Moreover, we developed methods for the facile fabrication of nanoribbon transistors on hard and flexible substrates, including polyimide, polyethylene terephthalate (PET), and novel temperature-responsive polymers. We have used soft formats for sensing in brain tissue and the spinal cord, and for wearable devices. We have demonstrated multiplexed serotonin, dopamine, pH, and temperature sensing via nanoribbon PET sensors. We have also developed custom hardware and software to control and record from up to eight FETs simultaneously. These and other efforts are enabling us to move toward multiplexed implantable and wearable sensing devices for use in animals and humans to improve understanding of behaviorally relevant information encoded by chemical modulators.