III. Device Concepts & Sensor/System Functionality

(A1) Experimental Characterization & Theoretical Interpretation of Microenvironments

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Biological homeostasis is maintained via intact function of an array of molecules detecting changes of microenvironments inside and outside of the biological system. These molecules including cell membrane proteins and ion channels are intimately involved in a variety of sensory pathways and respond to environmental stimuli, including altered temperature, pH, mechanical and osmotic stress, intra- and extracellular messengers, as well as changes in energy consumption. All of these modalities are involved in systemic, cellular, and molecular regulation. A better understanding of the structural, functional, and physiological properties of these proteins/ion channels would not only provide insight into mechanisms underlying disease processes but also facilitate fabrication of precisely defined, nanostructured interfacial architectures or molecular electronics that express and measure the activities of proteins/channels. These devices include but not limit to field-deployable networked biosensors, bioanalytical, and bio-surveillance devices, which will facilitate innovative high-throughput molecular and cellular sensing, investigation, and diagnosis of high-priority and emerging biological agents. Furthermore, chemical and biological species in such confined environments, from micro- to nanoscale, are currently under study for the purpose of engineering devices for electrical and computing functions as well as fabricating assays and sensors that are capable of molecule level detection. There is a need for measurements which are sensitive to intrinsically molecular scale, local phenomena, for systems comprised of single molecules and single molecular domains. Resolving structural, electrical, and chemical properties for a wide range of interfaces, especially epitaxial molecular thin films, as a function of local environment is particularly crucial. This involves probing molecular junctions and ordered molecular structures with high spatial and energy resolution with a spectrum of complementary experimental techniques and novel tools. Remarkable strides in the effort to integrate molecule based components into functional electronic devices can be made once a more fundamental understanding of the electrical, chemical, and physical driving forces at the nanoscale level is derived. Therefore, this session will focus on innovative research related to the experimental characterization and theoretical interpretation of microenvironments that have relevance for functional electronics and sensor applications.