Graphene-based Neural Interfaces for Probing Brain Activity

Abstract: The complexity of neural activities has challenged both neuroscience research and clinical practice for decades. Understanding neuronal dynamics and information processing performed by neural populations requires advanced technologies with high-resolution sensing and stimulation capability. Clinical neuromodulation therapies widely used for neurological disorders also depend on the ability to manipulate the dynamics of neural circuits. Conventional neural interfaces offering electrical, optical, or chemical signals have greatly advanced our understanding of neural functions, however, most of these technologies are based on a single functionality. Combining multiple functionalities in a single system has recently been pursued as an integrative approach in new neurotechnology development. Graphene has recently emerged as a neural interface material offering several outstanding properties, such as optical transparency, flexibility, high conductivity, functionalization and biocompatibility. The unique combination of these properties in a single material system makes graphene an attractive choice for multi-modal probing of neural activity. In this talk, I will present our recent work on graphene-based neural interfaces, highlight key applications, and finally discuss future directions and potential advances for graphene-based neurotechnologies in both basic neuroscience research and medical applications.