Injectable, 2D Material-Based Multimodal Sensor for Brain Disease

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Abstract

Over the past few decades, intracranial implants have been developed for the diagnosis and treatment of brain diseases. However, the platforms of these conventional implantable devices still rely on invasive probes and bulky sensors. These are typically used in conjunction with large-area craniotomies and provide only limited biometric information.
In this talk, we introduce an implantable multimodal sensor array that can be injected through a small hole in the skull. This sensor array inherently expands to make conformal contact with the cortical surface. The injectable sensor array is composed of graphene multi-channel electrodes for neural recording and electrical stimulation, and MoS_2-based sensors for monitoring intracranial temperature and pressure. The design is based on a mesh structure, the elastic restoring force of which enables the contracted device to expand.
We demonstrated that the sensor array, when injected into a rabbit's head, can detect epileptic discharges on the surface of the cortex and mitigate them through electrical stimulation. Simultaneously, it monitors both intracranial temperature and pressure. This method offers significant potential for the implantation of a variety of functional devices via minimally invasive surgery.