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GRAPHENE AND BEYOND
From Atoms to Applications

Graphene-based Electrochemical Devices for Biosensing and Real-time Cellular Studies

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Abstract

Routine monitoring of biochemical markers can improve diagnosis, treatment, and prognosis of various diseases. Among various biosensing methods, electrochemical methods account for the largest revenue share of 71% owing to their relatively simple readout, portability, and high sensitivity. Electrochemical biosensors have also been utilized in real time studies involving biological cells, for example in organ-on-chip platforms. Research into new materials and scalable fabrication techniques for electrochemical biosensors has been continuously growing. Over the past few years, there has been significant progress in electrochemical sensing using two-dimensional materials, specifically graphene, owing to their high specific surface area, rich surface chemistry, biocompatibility, favorable/tunable electrical conductivity, and scalable manufacturing techniques. Progress in stable solution-phase graphene inks has also advanced printed electronics, while direct writing of laser-induced graphene (LIG) has enabled integration of porous graphene in various low-cost substrates. In this talk, I will highlight our group's recent progress in printed electrochemical devices based on graphene ink and LIG for in vitro detection of small biomolecules as well as in situ and real-time monitoring of drug-induced response of cancer cells and bacterial biofilms. In addition, a novel machine learning-powered multimodal approach will be presented which offers significant enhancement of sensitivity, while enabling reliable multiplexing of biochemical markers in saliva and sweat.