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Nanomaterials-decorated laser-induced graphene for sensing applications

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Abstract: Laser-induced graphene (LIG) provides a single-step, cost-effective method for patterning three-dimensional porous carbon electrodes on flexible polyimide substrates. However, its standalone electrochemical performance often requires synergistic enhancement. This presentation highlights our recent advancements in developing highly sensitive, flexible electrochemical platforms by functionalizing LIG with catalytically active nanomaterials for biomedical diagnostics and food safety monitoring.

We introduce two surface modification strategies to amplify the electroactive surface area and electron transfer kinetics of LIG. The first strategy employs photodeposition to decorate LIG with gold nanoparticles (Au-NPs), enabling the simultaneous, highly sensitive detection of dopamine and acetaminophen in human serum samples. The second approach utilizes porous NiFe-Oxide nanocubes derived from Prussian blue analogues to selectively detect the synthetic antioxidant propyl gallate in complex food matrices. Additionally, to explore their applicability in point-of-care and on-site scenarios, these modified sensors were coupled with portable, smartphone-assisted potentiostats. This preliminary integration facilitates convenient data processing and rapid analysis, suggesting the feasibility of utilizing functionalized LIG architectures as a basis for practical sensing systems.

Keywords: *Laser-induced graphene, biosensor, chemical sensor, nanoparticle, porous, dopamine, acetaminophene, propyl gallate*