Laser-Induced Graphene-Based Biosensor for Non-enzymatic Amperometric Detection of Creatinine as a Kidney Biomarker

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Abstract:

Chronic kidney disease (CKD) poses a global health burden due to its elevated prevalence and silent progression over months or years. Creatinine, a key metabolic byproduct of muscle metabolism, serves as an essential biomarker for assessing kidney function and enables the early detection and monitoring of chronic kidney disease (CKD). Herein, we developed a non-enzymatic amperometric biosensor for creatinine detection based on a laser-induced graphene (LIG) platform. LIG acts as an efficient transducer for sensitive electrochemical measurements due to its high electrical conductivity, large surface area, and ease of fabrication. The electrode surface was modified with cuprous oxide–bovine serum albumin (Cu_2O–BSA) nanoparticles, which function as a stable electrocatalyst for creatinine oxidation. Amperometric measurements revealed a linear detection range from 10 µM to 5 mM and a limit of detection (LOD) of approximately 20 µM, demonstrating the sensor's capability for clinically relevant creatinine monitoring.

Keywords:

Creatinine, Cu2O–BSA NPs, Laser-induced graphene, non-enzymatic amperometric biosensor.