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Facile Fabrication of Ascorbic Acid Reduced Graphene Oxide-Modified Electrodes toward Electroanalytical Determination of Sulfamethoxazole in Aqueous Environments

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Abstract

In the present work, a novel reduced graphene oxide (rGO)-based electrochemical sensor has been developed for the detection of sulfamethoxazole (SMZ) using differential pulse voltammetry. Ascorbic acid (AA) under acid conditions has proven to be an efficient yet environmentally benign reductant to recover the outstanding electrochemical activity of graphene. Additionally, the ascorbic-acid-reduced graphene oxide exhibits a high total removal rate of epoxide and hydroxyl functional groups, with a rich presence of carbonyl and carboxyl functional groups, allowing an excellent solution processing ability for realizing further functionalization and applications, unlike reduced graphene oxide reduced by conventional harmful reductants (e.g., hydrazine). Moreover, excellence in the determination of SMZ is likely due to selective reduction of oxygen functional groups on the graphene basal planes by ascorbic acid, which enhances π–π interactions with SMZ, which is present in anionic forms in natural aqueous systems. The AArGO-modified electrodes achieved a linear range of 0.5-50 μM with a limit of detection of 0.04 μM and satisfied recoveries in different water samples. Additionally, the cationic surfactant (e.g., cetyltrimethylammonium bromide, CTAB) showed a promoting effect toward SMZ determination. Collectively, the AArGO modified electrodes showed great improvement in the anodic oxidation reactivity of SMZ with high selectivity and stability, allowing promising and feasible applications in on-site environmental monitoring.