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Electrochemical detection of sunset yellow using graphene modified electrodes

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The human health is highly affected by the usage of synthetic dyes in foods and drinks. The dyes are generally added to improve the appearance, color and taste of food but if the intake exceeds a certain amount, it may be pathogenic. Sunset Yellow (SY) belongs to the azo-dye family and contains an azo functional group (N=N) and aromatic rings, which may be harmful to human health. Since it is less expensive and more stable than natural dyes, SY is frequently used in food products (e.g., orange juice). According to the World Health Organization, the accepted daily intake value for sunset yellow is 0–4 mg.kg−1 and its concentration in non-alcoholic beverages should not exceed 50 mg.L−1. Its detection by electrochemical technique using graphene modified electrodes may be a viable alternative to the more laborious HPLC method. Graphene-based materials were prepared by exfoliation of graphite rod via pulses of current in solutions containing various electrolytes e.g., ammonium sulfate; a mixture of boric acid and sodium chloride; and a mixture of nitric and sulfuric acid. The samples were correspondingly denoted Gr-AS, Gr-BA and Gr-NS. After washing and lyophilization, the samples were morphologically and structurally characterized by transmission/scanning electron microscopy, X-ray powder diffraction (XRD), X-ray photoelectron spectroscopy (XPS) and Raman spectroscopy. According to XRD spectra, the Gr-AS and Gr-BA samples (prepared in the first two electrolytes) contain few-layer and multi-layer graphene flakes. In contrast, the Gr-NS sample prepared in the third electrolyte contains not only few and multi-layer graphene flakes but also a large amount of graphene-oxide (39%). The performances of glassy carbon (GC) electrodes modified with the graphene based materials were tested toward sunset yellow (SY) detection and compared with those of bare GC. As expected, the graphene modified electrodes have higher sensitivities, wider linear ranges and lower detection limits.

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