Biochar-modified carbon paste electrode as an advanced material for electrochemical investigation of pesticide mancozeb

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Biochar (BC) is a carbonaceous material produced from naturally abundant raw materials (biomasses – mostly from the agricultural tailing and forestry ecosystem wastes or municipal wastes) *via* a pyrolysis process. With the growth of green chemistry concepts, the preparation and application of BC have attracted strong interest owing to the combination of fascinating physicochemical properties including large surface area, high porosity, surface charge, sustainability and low-cost which are beneficial in various fields, such as the remediation of polluted environments, soil amendments, wastewater treatment, and electrochemical sensors [1–3]. From the various electrode materials available nowadays, the classical carbon paste electrode (CPE) has widespread popularity as a working electrode due to its unique properties such as wide potential range, long-time stability, good conductivity, renewable surface, ease of preparation and modification, whereby the modifying agents can be added directly to the paste, either to the material in its final state or during its preparation [4]. In this work, CPE was bulk modified with biochar obtained from the hardwood source (BC-CPE) with the aim to develop a reliable alternative method for the determination of broad-spectrum fungicide mancozeb (MCZ). Cyclic voltammetric experiments showed that the oxidation of MCZ is irreversible and an adsorption control process at the BC-CPE surface. In the next step, a simple, sensitive and selective electroanalytical method for the determination of MCZ using differential pulse adsorptive stripping voltammetry (DP-AdSV) was proposed. Optimization of various experimental parameters was carried out including the pH of the supporting electrolyte, the amount of the modifier and the preconcentration step. At pH 7.0 of Britton-Robinson buffer, with accumulation potential of -0.2 V and accumulation time of 30 s, a linear relationship between MCZ concentration and peak current intensity was established between 0.025 and 2.78 μg mL^{-1}, the relative standard deviation did not exceed 3%, while achieved detection limit in the model solution was 7.5 ng mL^{-1}. The BC-CPE showed adequate selectivity for MCZ in the presence of various interfering compounds. The obtained results indicate that BC-CPE with an optimized DP-AdSV method could be applied for the trace-level electroanalytical determination of MCZ in real samples.

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