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A highly selective electrochemical sensor by using bimetallic metal organic framework for the detection of 3-Monochloropropane-1,2-diol esters (3-MCPDEs)

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Abstract
3-Monochloropropane-1,2-diol esters (3-MCPDEs) are hazardous contaminants in heat-processed foods, raising serious food safety concerns. In this study, a high-performance Fe-Mn-MOF/NIF sensor was developed via a simple hydrothermal method for rapid and precise 3-MCPDEs detection. Structural and morphological analyses confirmed the sensor stability, with FTIR revealing strong interactions between (-CH) and (O-H) stretching vibrations, while XRD indicated slight crystal distortion upon detection. FESEM and TEM confirmed minimal aggregation, ensuring homogeneous iron (Fe) and manganese (Mn) distribution. The sensor exhibited a large surface area, significantly enhancing its detection capability. Using square wave voltammetry (SWV) method, it achieved a broad linear range (0.05–255 μM), low detection limit (0.002 μM), and exceptional sensitivity (43.71 μA μM−1 cm−2). Comparative analysis with GC-MS demonstrated comparable accuracy, while real-sample testing in soy sauce confirmed high recovery rates. Unlike conventional methods, this sensor enables cost-effective, rapid, and on-site detection, offering a transformative approach for food safety monitoring. With its superior performance, the Fe-Mn-MOF/NIF sensor presents a breakthrough in electrochemical detection, paving the way for enhanced food quality control and public health protection. © 2025 The Authors

Author Keywords
2-propanediol esters; 3-chloro-1; Cyclic voltammetry; Electrochemical impedance spectroscopy; Metal-organic framework; Square wave voltammetry

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