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Synthesis, characterization and catalytic performance of nanostructured dysprosium molybdate catalyst for selective biomolecule detection in biological and pharmaceutical samples(Article)

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Abstract

The current study reports a new, simple and fast method using a flake-like dysprosium molybdate (Dy_2MoO_6; FL-DyM) nanostructured material to detect the antibiotic drug metronidazole (METZ). This nanocomposite material was employed on the surface of a glassy carbon electrode (GCE) to develop the electrode (FL-DyM/GCE). Further, the synthesized FL-DyM was systematically characterized by powder X-ray diffraction (XRD), Raman spectroscopy, scanning electron microscopy (SEM), transmission electron microscopy (TEM), energy-dispersive X-ray diffraction (EDS), elemental mapping, X-ray photoelectron spectroscopy (XPS), and Brunauer-Emmett-Teller (BET) analyses. Cyclic (CV) and differential pulse voltammetry (DPV) techniques were used to study the electrochemical properties. The FL-DyM/GCE-based sensor demonstrated excellent selectivity and sensitivity for the detection of the drug METZ, which could be attributed to the strong affinity of FL-DyM towards the -NO_2 group in METZ, and the good electrocatalytic activity and conductivity of FL-DyM. The fabrication and optimization of the working electrode were accomplished with CV and DPV obtained by scan rate and pH studies. Compared to the bare GCE and other rare-earth metal molybdates, the FL-DyM/GCE sensor displayed a superior electrocatalytic activity response for METZ detection. The sensor demonstrated a good linear relationship over the concentration range of 0.01-2363 μM. The quantification and detection limits were found to be 0.010 μM and 0.0030 μM, respectively. The FL-DyM/GCE sensor displayed excellent selectivity, repeatability, reproducibility, and stability for the detection of METZ in human urine and commercial METZ tablet samples, which validates the new technique for efficient drug sensing in practical applications. © 2019 The Royal Society of Chemistry.

Indexed keywords

Engineering controlled terms: Dysprosium | Electrochemical sensors | High resolution transmission electron microscopy | Molybdenum compounds | Nanocatalysts | Nanocomposites | Negative ions | Rare earths | Scanning electron microscopy | Voltammetry | X ray diffraction | X ray photoelectron spectroscopy

Engineering uncontrolled terms: Brunauer emmett tellers | Differential pulse voltammetry | Electrocatalytic activity | Energy dispersive x-ray diffractions | Glassy carbon electrodes | Powder X ray diffraction | Rare-earth metal molybdates | Selectivity and sensitivity

Engineering main heading: Glass membrane electrodes

EMTREE drug terms: carbon, dysprosium, graphite, metronidazole, molybdenum, molybdic acid, nanocomposite

EMTREE medical terms: catalysis, chemistry, electrochemical analysis, electrode, human, limit of detection, pH, procedures, reproducibility, tablet, urine

MeSH: Carbon, Catalysis, Dysprosium, Electrochemical Techniques, Electrodes, Graphite, Humans, Hydrogen-Ion Concentration, Limit of Detection, Metronidazole, Molybdenum, Nanocomposites, Reproducibility of Results, Tablets

Topic:

Prominence percentile:

Chemicals and CAS Registry Numbers:

carbon, 7440-44-0; dysprosium, 7429-91-6; graphite, 7782-42-5; metronidazole, 39322-38-8, 443-48-1; molybdenum, 7439-98-7; molybdic acid, 11116-47-5, 14259-85-9, 7782-91-4;

Carbon; Dysprosium; Graphite; Metronidazole; molybdate; Molybdenum; Tablets

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