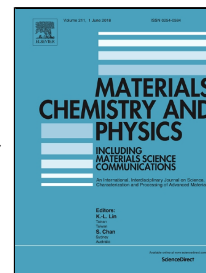


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Novel two-step process for the fabrication of MnO₂ nanostructures on tantalum for enhanced electrochemical H₂O₂ detection

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Abstract

We demonstrate the influence of MnO₂ nanostructures on the H₂O₂ sensing performance. A novel two-step process using hydrothermal synthesis and spray pyrolysis deposition was used to fabricate the MnO₂/Ta sensor electrode. First, different MnO₂ nanostructures were synthesized by temperature controlled autoclave-hydrothermal processing through the manipulation of Mn concentration. The MnO₂ nanoparticles revealed preferentially oriented (101) peak with high intensity. The absorption bands at 760-375 cm⁻¹ confirmed the coupling between Mn-O stretching modes of tetrahedral and octahedral sites. SEM images revealed the formation of horn-like MnO₂ nanowires and nanoflakes with good crystallinity. The MnO₂ nanoflakes synthesized with 3 at.% Mn exhibit needle like morphology at the edge of nano-architecture, favorable for remarkable electrochemical properties and stability. Next, the MnO₂ nanostructures were transferred onto Ta electrode by a novel spray deposition to form a multi-terminal network H₂O₂ adsorption layer. The 3D nanoflakes like MnO₂/Ta electrode revealed a very low detection limit of 0.06 μM towards H₂O₂, with insignificant responses for interfering compounds. The sensor also displayed good recovery >95% when tested in milk samples.

Keywords: MnO₂ nano-flakes; electrochemical sensor; spray pyrolysis method; H₂O₂ detection;

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