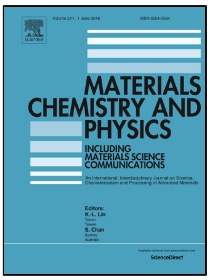
Accepted Manuscript



Novel two-step process for the fabrication of MnO_2 nanostructures on tantalum for enhanced electrochemical H_2O_2 detection

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PII:	S0254-0584(18)30378-X
DOI:	10.1016/j.matchemphys.2018.04.108
Reference:	MAC 20603
To appear in:	*Materials Chemistry and Physics*
Received Date:	18 July 2017
Revised Date:	02 February 2018
Accepted Date:	30 April 2018

Please cite this article as: K. Vijayalakshmi, A. Renitta, K. Alagusundaram, A. Monamary, Novel two-step process for the fabrication of MnO_2 nanostructures on tantalum for enhanced electrochemical H_2O_2 detection, *Materials Chemistry and Physics* (2018), doi: 10.1016/j.matchemphys.2018.04.108

Novel two-step process for the fabrication of MnO_2 nanostructures on tantalum for enhanced electrochemical H_2O_2 detection

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Abstract

We demonstrate the influence of MnO_2 nanostructures on the H_2O_2 sensing performance. A novel two-step process using hydrothermal synthesis and spray pyrolysis deposition was used to fabricate the MnO_2/Ta sensor electrode. First, different MnO_2 nanostructures were synthesized by temperature controlled autoclave-hydrothermal processing through the manipulation of Mn concentration. The MnO_2 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 MnO_2 nanowires and nanoflakes with good crystallinity. The MnO_2 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 MnO_2 nanostructures were transferred onto Ta electrode by a novel spray deposition to form a multi-terminal network H_2O_2 adsorption layer. The 3D nanoflakes like MnO_2/Ta electrode revealed a very low detection limit of 0.06 µM towards H_2O_2, with insignificant responses for interfering compounds. The sensor also displayed good recovery >95% when tested in milk samples.

Keywords: MnO_2 nano-flakes; electrochemical sensor; spray pyrolysis method; H_2O_2 detection;

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