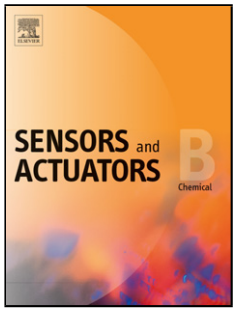

Title: 2D metal oxide nanoflakes for sensing applications: Review and perspective

Authors: A. Petra Dral, Johan E. ten Elshof

PII: S0925-4005(18)31065-7
DOI: https://doi.org/10.1016/j.snb.2018.05.157
Reference: SNB 24813

To appear in: *Sensors and Actuators B*

Received date: 18-1-2018
Revised date: 18-5-2018
Accepted date: 26-5-2018

Please cite this article as: A.Petra Dral, Johan E.ten Elshof, 2D metal oxide nanoflakes for sensing applications: Review and perspective, Sensors and Actuators B: Chemical https://doi.org/10.1016/j.snb.2018.05.157

2D metal oxide nanoflakes for sensing applications: Review and perspective

A. Petra Dral,[a] Johan E. ten Elshof[a,]*

[a] *Inorganic Materials Science, MESA+ Institute for Nanotechnology, University of Twente, P.O. Box 217, 7500 AE Enschede, The Netherlands. E-mail addresses: a.p.dral@utwente.nl, j.e.tenelshof@utwente.nl*

** Corresponding author*

Abstract

In this review the state of the art and future prospects of 2-dimensional (2D) metal oxide nanoflakes used as active sensing elements for the detection of solutes, gases and radiation are discussed. 2D material geometries are particularly interesting for sensing applications because they provide large specific surface areas and are suitable for crystal facet engineering. In addition, unique material properties of atomically thin nanosheets due to quantum size effects provide engineering possibilities beyond the realm of their bulk counterparts. A variety of possibilities in materials, synthesis routes, (hierarchical) sensor architectures and application areas is sketched. The discussion is focused on high-performing sensors and innovative concepts. The scope is limited to nanoflakes with a thickness of up to 50 nm. Special attention is given to sensing based on material properties that are unique to atomically thin nanosheets.

Keywords: two-dimensional, metal oxide, nanosheet, biosensor, gas sensor, hierarchical architecture

1. Introduction

Many industries and day-to-day technologies rely on sensors for safety, quality control and analysis. Sensors are required to detect i.e. specific gases, biomolecules or radiation with sufficient sensitivity, selectivity, speed and stability ('4S' requirements). Using 2D sensing elements has several advantages as opposed to using bulk 3D units of the same material. Freestanding 2D nanoflakes have a large specific surface area, which enables extensive interaction with the environment even for small amounts of material. Also, rigid 2D building blocks can facilitate an open packing in 3D assemblies when they are immobilized in a non-stacking fashion. In comparison with 3D architectures derived from 1D or 0D components, 2D-in-3D architectures can provide more efficient electron transport because of fewer grain boundaries and they also tend to have a better mechanical stability [1,2]. Using 2D subunits furthermore