

## Accepted Manuscript

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PII: S0169-4332(17)31115-7  
DOI: <http://dx.doi.org/doi:10.1016/j.apsusc.2017.04.097>  
Reference: APSUSC 35778

To appear in: *APSUSC*

Received date: 1-3-2017  
Revised date: 5-4-2017  
Accepted date: 13-4-2017



Please cite this article as: A.A. Mane, A.V. Moholkar, Effect of film thickness on NO<sub>2</sub> gas sensing properties of sprayed orthorhombic nanocrystalline V<sub>2</sub>O<sub>5</sub> thin films, *Applied Surface Science* (2017), <http://dx.doi.org/10.1016/j.apsusc.2017.04.097>

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## Effect of film thickness on NO<sub>2</sub> gas sensing properties of sprayed orthorhombic nanocrystalline V<sub>2</sub>O<sub>5</sub> thin films

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### Abstract

The nanocrystalline V<sub>2</sub>O<sub>5</sub> thin films with different thicknesses have been grown onto the glass substrates using chemical spray pyrolysis (CSP) deposition method. The XRD study shows that the films exhibit an orthorhombic crystal structure. The narrow scan X-ray photoelectron spectrum of V-2p core level doublet gives the binding energy difference of 7.3 eV, indicating that the V<sup>5+</sup> oxidation state of vanadium. The FE-SEM micrographs show the formation of nanorods-like morphology. The AFM micrographs show the high surface area to volume ratio of nanocrystalline V<sub>2</sub>O<sub>5</sub> thin films. The optical study gives the band gap energy values of 2.41 eV, 2.44 eV, 2.47 eV and 2.38 eV for V<sub>2</sub>O<sub>5</sub> thin films deposited with the thicknesses of 423 nm, 559 nm, 694 nm and 730 nm, respectively. The V<sub>2</sub>O<sub>5</sub> film of thickness 559 nm shows the NO<sub>2</sub> gas response of 41 % for 100 ppm concentration at operating temperature of 200 °C with response and recovery times of 20 s and 150 s, respectively. Further, it shows the rapid response and reproducibility towards 10 ppm NO<sub>2</sub> gas concentration at 200 °C. Finally, NO<sub>2</sub> gas sensing mechanism based on chemisorption process is discussed.

**Keywords:** Nanocrystalline V<sub>2</sub>O<sub>5</sub> thin films; Chemical spray pyrolysis; XPS; NO<sub>2</sub> gas sensor

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