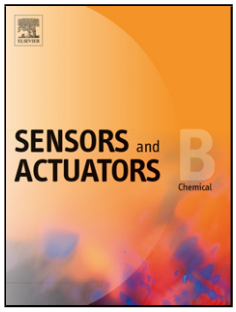

Title: Gas sensors based on ytterbium ferrites nanocrystalline powders for detecting acetone with low concentrations

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PII: S0925-4005(17)30103-X
DOI: http://dx.doi.org/doi:10.1016/j.snb.2017.01.096
Reference: SNB 21621

To appear in: *Sensors and Actuators B*

Received date: 6-5-2016
Revised date: 20-12-2016
Accepted date: 13-1-2017

Please cite this article as: Panpan Zhang, Hongwei Qin, Wei Lv, Heng Zhang, Jifan Hu, Gas sensors based on ytterbium ferrites nanocrystalline powders for detecting acetone with low concentrations, Sensors and Actuators B: Chemical http://dx.doi.org/10.1016/j.snb.2017.01.096

Abstract

The ytterbium ferrites nanocrystalline powders were prepared by sol–gel method, followed by the subsequent annealing, which exhibit considerable response to acetone gas. The ytterbium ferrite crystallizes as mixed phases of $YbFeO_3$-$Yb_2Fe_3O_7$ when annealed at 700 °C and 800°C, but as single phase $YbFeO_3$ annealed at 900 °C, respectively. When exposed to acetone gas, the resistance increases for n-type $YbFeO_3$ but decreases for mixed phases of $YbFeO_3$-$Yb_2Fe_3O_7$. The sensing properties for $YbFeO_3$-$Yb_2Fe_3O_7$ may be mainly associated with the charge order (CO) state of $Yb_2Fe_3O_7$. The maximum sensitivities to 1 and 3ppm acetone gas in the background of air (with the room temperature humidity 33% RH) for sensor based on $YbFeO_3$- $Yb_2Fe_3O_7$ (with T_A=800 °C) are about 1.21 and 1.42 respectively at optimal operating temperature of 250 °C. The appropriate replacement of Yb by Ca (about 20 at.%) in $YbFeO_3$ annealed at 900 °C not only decreases the resistance but also enhances the sensing response greatly. With increase of room temperature humidity, the sensing response of $Yb_{0.8}Ca_{0.2}FeO_3$ sensor increases. The response for $Yb_{0.8}Ca_{0.2}FeO_3$ in the background of air (with the room temperature humidity 90% RH) at its optimal temperature of 230 °C is 2.1, 3.9, 4.3, 9.5 and 15.0 to 0.1, 0.3, 0.5, 1 and 3 ppm acetone gas, respectively. $Yb_{0.8}Ca_{0.2}FeO_3$ sensor may be a promising candidate for developing a breath analysis technique for monitoring diabetes. The sensing mechanisms of ytterbium ferrites to acetone are also discussed.