

GAS SENSOR PERFORMANCES OF α -MoO₃ BELTS NANOSTRUCTURED WITH Pd

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Molybdenum trioxide (MoO₃) due to its unique physical and chemical properties is one of the most attractive candidates for different promising technological applications [1]. α -MoO₃ has a unique morphology that resembles a structure of layered graphene [2]. Due to the layered structure and high chemical stability MoO₃ is used for such applications as gas sensors, recording or storage materials, lubricants, electrochromism, and fotochromism [3]. Meanwhile, MoO₃ is a promising material for catalysts [4], the field emission, light emitting diode, and energy storage elements [5], etc., because of its electrical and optical properties. Nanobelts shaped nanostructures of MoO₃ are of major interest due to various gas properties and simple integration technology for bottom-up and the possibility of obtaining cost-effective technologies. Their major drawback is the high surface-to-volume ratio. The increased gas response was obtained by nanostructuring of α -MoO₃ nanostructure surface with an aqueous solution of PdCl₂ presented in our previous work [6].

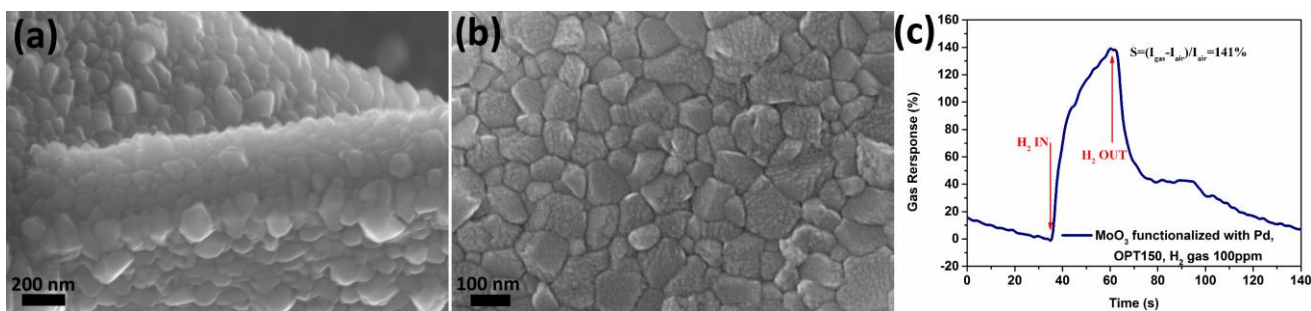


Figure 1. (a) The SEM images of the nanogranulate belts Pd / α -MoO₃ with scale bar of 200 nm; (b) The SEM images of the nanogranulate belts Pd / α -MoO₃ after the application of hydrogen gas tests; (c) Gas response measurements to hydrogen gas of nanostructured Pd / α -MoO₃.

In Figure 1 (a) is provided the surface after the chemical reaction with aqueous PdCl₂ solution. The belts surface of α -MoO₃ becomes nanostructured by forming nanocrystallites or nanogranulates. Layered morphology of the belts is not modified by reaction with PdCl₂ and obvious changes in morphology of α -MoO₃ belts was not observed. It was observed that after the reduction with hydrogen in Figure 1 (b), the surface concentration of the Mo⁶⁺, decreases greatly by reducing of Mo⁵⁺ and the Mo⁴⁺. H⁺ ions interact mainly with oxygen atoms double coordinated from network, leading to the formation of hydrogen molybdenum bronze (H_xMoO₃) and MoO₃ substoichiometric (MoO_{3-x}). Response to H₂ gas is calculated using the formula $S = ((I_{\text{gas}} - I_{\text{air}}) / I_{\text{air}}) * 100\%$ thereby obtaining a response of 141% at operating temperature of 150 °C, response time 17 s and the partial recovery time is 9 s. The samples did not demonstrate a full recovery of the signal due to changes in surface morphology.

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