Transition Metals Oxide-Semiconductor Nanowires' Arrays with ZnO Core-Shell as Efficient Gas Sensors

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Gas detection finds application in any environment requiring air quality control, such as industrial sites, medicine and science applications, and other vast variety of home appliance products such as domestic gas alarms [1]. Metal-oxide-semiconductor sensors, whose operating principle relies on the resistivity changes upon contact with the specific gas, became widely used, because of their high sensitivity, relatively low production costs and possible compact size of the device. [2] The continuous development of electronics and miniaturization demands other concepts to be explored, especially those related to sensitivity, ease of use in versatile environments, and the reduction of energy consumption [3]. This makes them interesting subjects for further research to investigate their properties and pave the way for better performance.

The basic principle of metal-oxide-semiconductor sensor operation are the chemical redox reactions, which occur on the surface thus changing electrical resistance [2]. Therefore, the sensitivity and overall operation performance heavily rely on the active surface-to-volume ratio, which promotes materials with a well-developed surface such as nanowire arrays. Within this work, we present the synthesis and characterization of core-shell nanowire sensors. A mesh of transition metal nanowires (inter alia Co, Mn and V) was obtained in a single-step, solution-originated technique. The ability of block copolymers (BCPs) to self-assemble into various nanoscale morphologies including cylinders offers, through deposition, ordering and chemical conversion to yield metal-oxide nanopatterns on silicon substrate. [3] (Fig. 1) These arrays were subsequently coated with a ZnO shell, grown with atomic layer deposition technique (ALD) to further elevate the gas sensing capabilities.

In this paper we will show the influence of the kind of oxides and morphology of the obtained structures on their sensitivity level (Fig. 2), meaning their electrical response upon volatile organic compound encounter.

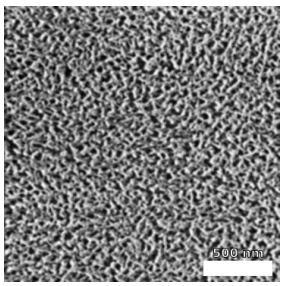

Figure 1 SEM image of a stack of chromium oxide nanowires.

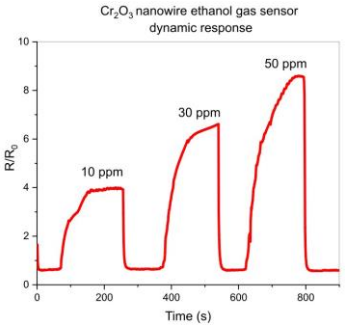

Figure 2 Chromium oxide nanowire ethanol gas sensor dynamic response.

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