Hierarchically Nanostructured Metal Oxide Gas Sensors

Mohammad R. Alenezi
College of Technological Studies, PAAET, P.O. Box 42325 Shuwaikh, (Kuwait)
Mr.alenezi@paaet.edu.kw

Hierarchical nanostructures with higher dimensionality, consisting of nanostructure building blocks such as nanowires, nanotubes, or nanosheets are very attractive. They hold great properties like the high surface-to-volume ratio and well-ordered porous structures, which can be very challenging to attain forother mono-morphological nanostructures. Well-ordered hierarchical nanostructures with high surface-to-volume ratios facilitate gas diffusion into their surfaces as well as scattering of light. Therefore, hierarchical nanostructures are expected to perform highly as gas sensors.[1-3]

A multistage controlled hydrothermal synthesis method to fabricate high performance single ZnO brush-like hierarchical nanostructure gas sensor from initial nanowires is reported (Fig. 1). The performance of the sensor based on brush-like hierarchical nanostructure is analyzed and compared to that of a nanowire gas sensor (Fig. 2). The hierarchical gas sensor demonstrated high sensitivity toward low concentration of acetone at high speed of response. The enhancement in the hierarchical sensor performance is attributed to the increased surface to volume ratio, reduction in dimentionality of the nanowire building blocks, formation of junctions between the initial nanowire and the secondary nanowires, and enhanced gas diffusion into the surfaces of the hierarchical nanostructures.

Figures

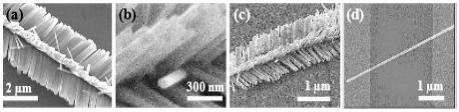

Figure 1: (a) Low and (b) high magnification SEM imagesof the hierarchical brush-like nanostructure; (c) a singlebrush-like hierarchical nanostructure, and (d) single nanowire gas sensor.

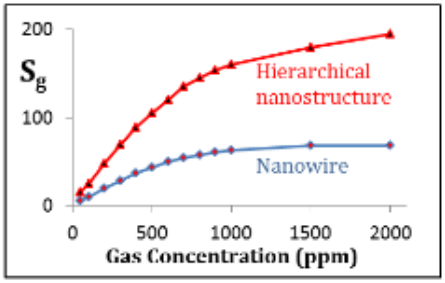

Figure 2: Gas response of the single hierarchical brush-like nanostructure versus the single nanowire gas sensor.

References

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[3] M. R. Alenezi, A. S. Alshammari, T. H. Alzanki, P. Jarowski, S. J. Henley, and S. R. P. Silva, Langmuir, (2014), 30, 3913–3921.