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Localized Synthesis of Iron Oxide Nanowires and Fabrication of High Performance Nanosensors Based on a Single Fe2O3 Nanowire

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Abstract

A composed morphology of iron oxide microstructures covered with very thin nanowires (NWs) with diameter of 15–50 nm has been presented. By oxidizing metallic Fe microparticles at 255 °C for 12 and 24 h, dense iron oxide NW networks bridging prepatterned Au/Cr pads are obtained. X-ray photoelectron spectroscopy studies reveal formation of α-Fe2O3 and Fe3O4 on the surface and it is confirmed by detailed high-resolution transmission electron microscopy and selected area electron diffraction (SAED) investigations that NWs are single phase α-Fe2O3 and some domains of single phase Fe3O4. Localized synthesis of such nano- and microparticles directly on sensor platform/structure at 255 °C for 24 h and reoxidation at 650 °C for 0.2–2 h, yield in highly performance and reliable detection of acetone vapor with fast response and recovery times. First nanosensors on a single α-Fe2O3 nanowire are fabricated and studied showing excellent performances and an increase in acetone response by decrease of their diameter was developed. The facile technological approach enables this nanomaterial as candidate for a range of applications in the field of nanoelectronics such as nanosensors and biomedicine devices, especially for breath analysis in the treatment of diabetes patients.