IEEE 12th International Conference
Nanomaterials: Application & Properties (NAP)
2022, 11-16 September, Krakow, Poland

Nano-Heterostructured Materials - Based Sensors for Safety and Biomedical Applications

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https://doi.org/10.1109/NAP55339.2022.9934724

Abstract

Permanent monitoring of lithium-ion batteries (LIBs) and volatile organic compounds (VOCs) in various environments, especially for safety and biomedical applications, is a growing field due to the high reactivity of the materials used, which require specialized sensor structures. In this work, we summarize the detection performance of metal oxide heterostructures against battery solvents and volatile organic compounds and propose a way to tailor the sensor selectivity by modifying structural properties on the nanoscale. Therefore, the oxides are grown by a simple chemical solution method and by thermal layer deposition followed by thermal annealing at various temperatures. Subsequently, the morphology and structure as well as the electronic, chemical, and sensing properties of the formed semiconducting oxide heterostructures are investigated. Gas sensing studies have shown that the surface coverage with metal oxides and the formation of nano-heterostructures is an efficient approach to improve the LIB electrolyte sensing. The present approach demonstrates that the combination of the ability to sense the electrolyte vapors used in LIBs and the size control of different oxides enabled by the used synthesis route makes these nano-heterostructures extremely attractive for all kinds of sensing purposes, especially for battery safety control and biomedical applications. Our developments are very important for future LIB sensors and necessary for understanding the effect of the heterostructure type and the thickness of the top nanofilm on the gas response, which thus far has not been reported in the literature.

Keywords: temperature sensors, volatile organic compounds, temperature distribution, metals, electrolytes, batteries, zinc oxide, aluminium oxide, copper oxide, heterojunctions, sensors, gas response

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