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Reduction-oxidation of V2O5-WO3 nanostructured by ball milling and annealing: Their improved H2S gas sensing performance

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Abstract

Nanocrystalline composite VO2-WO3 powder was produced via mechanical milling (MM) and annealing. SEM images showed the formation of rod-shaped and hollow-shaped like structures surrounded by nanoparticles. Transmission electron microscopy and selected area electron diffraction analyses demonstrated that the nanorods are single crystalline. X-ray diffraction technique was used to determine the structural transformation of the powder after mechanical milling and annealing. The mechanism related to the formation of ceramic composite powder was discussed in detail. The findings showed that the MM has created the instability in the crystal structure, inducing additional surfaces on the V2O5-W-C powder, which made it more reactive and some oxygen atoms were depleted. The presence of W which has high affinity for oxygen adsorption and oxidization, resulted to a formation of WO3. In addition, the prospective application of V2O5-W-C composite in gas sensing was investigated towards H2S and H2 gases at 300 °C. The 30 h V2O5-W-C-650 °C-based sensor exhibited improved sensing response and excellent sensitivity towards H2S gas. The fundamental sensing mechanism related to H2S gas was also discussed.