ZnO/TiO_2 p/p^+ heterojunctions for hydrogen gas sensors at room temperature

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Abstract

Oxide gas sensors operating at room temperature are in increasing demand. ZnO and TiO_2 are suitable materials because they are easily available with moderately low cost of productions and high sensitivity to reducing and oxidizing gases. Recently a Co_2O_3/SnO_2 p-n structure has been reported for gas sensors [1].

In this article we report on the fabrication of ZnO/TiO_2 p/p^+ heterojunctions and the electrical characteristics in air and in hydrogen at room temperature. The oxide heterojunctions were fabricated using two separate growth techniques. A solid solution of high purity titanium and aluminium (2-wt%) was prepared in a "Tungsten Inert Gas" (TIG) electric arc furnace. Using this solid solution a thin film was deposited onto a cleaned alumina substrate by e-beam evaporation. This film yielded rutile TiO_2 upon oxidation at 950 ^oC for 1 hour in 1% O_2/Ar ambient. Thin-film of ZnO was deposited onto a selected area (by masking) of this TiO_2 film by an indigenously modified chemical vapour deposition (CVD) method using zinc acetate solution (in methanol) as the precursor [2]. Palladium dots were deposited onto the ZnO surface to fabricate $Pd/ZnO/TiO_2$ configurations for this study.

The junction parameters were calculated for different concentrations of hydrogen (500-2000 ppm). The junction ideality factor improved with the increasing hydrogen concentration. The response time at 500 ppm hydrogen was calculated to be 127 s which is faster than that reported for Pd/ZnO/Si n-p heterojunctions [3]. The other sensor parameters like sensitivity and reversibility have been studied along with a detailed analysis of the sensing mechanism.

Reference:

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