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Highly selective PbS thin film based ammonia sensor for inert ambient: In-situ Hall and photoelectron studies

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Abstract:

Granular thin films of p-type semiconducting PbS (Cubic) with predominantly a-axis oriented grains having an average grain size of about 300 nm were deposited on polycrystalline alumina by pulsed laser deposition technique. Optical measurements show a band gap of 2.25 eV. The thin films were highly selective to ammonia at 473 K even in the presence of hydrogen and they operate in inert ambient with a typical response and recovery times of about 25 s and 120 s respectively. In-situ Hall measurements show an exponential decrease in hole carrier concentration with increasing NH₃ level. XPS analysis of Pb 4f and S 2p levels reveals that the valence state of Pb and Sulphur remain in +2 and -2 respectively after exposure to the reducing ammonia and the appearance of N 1s peak at 398.1 eV confirms dissociative chemisorption of ammonia on PbS surface.

Keywords: Pulsed laser deposition; Lead sulphide; Ammonia sensor; Hall studies.

1. Introduction:

During the past few decades, semiconductor oxide based sensors were developed for monitoring toxic and harmful gaseous species in the environment [1-4]. These sensors require oxygen for sensing and regeneration. The widely accepted mechanism of sensing proposed for semiconductor oxides (n-type) like SnO₂ [5, 6], In₂O₃ [7], ZnO [8] etc., involves the

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