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Effect of seed layer thickness on chemically deposited ZnO nanowires for H_2 gas sensors

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Gas sensors play an important role in environmental monitoring. One-dimensional nanowires have superior sensing properties due to their high surface-to-volume ratio. This study used chemical bath deposition (CBD) to synthesize vertically aligned ZnO nanowires. The seed layer and its thickness are two crucial parameters in CBD to synthesize vertically aligned, well-grown ZnO nanaowires. Therefore, this study mainly focused on synthesizing highly oriented, uniformly distributed nanowires to fabricate H_2 sensitive gas sensors by optimizing seed layer thickness. ZnO Nanaowires were grown on ZnO seeded borosilicate substrates. The seed layer was deposited using the jet nebulizer spray pyrolysis method. Seed layer stacks ranged from 5 to 15 layers. The effect of seed layer thickness on nanowires was studied using structural (XRD), morphological (SEM), and optical (UV-Visible spectroscopy) properties. According to the SEM analysis, the thicknesses of the deposited ZnO seed layers were 20 nm, 35 nm and 40 nm respectively. XRD analysis revealed that the synthesized ZnO nanowires showed a hexagonal structure, which was preferentially oriented in the (002) plane. SEM images confirmed the vertical orientation of ZnO nanowires on the substrate. According to that, nanowires grown on the seed layer with 40 nm thickness observed the highest length and the lowest diameter with the highest surface density. Gas sensing results showed the highest response change of $4.4 - 100$ ppm H_2 at 150 °C for the nanowires grown on the 40 nm seed layer. The optimum seed layer thickness was found to be 40 nm.

Keywords: Chemical bath deposition, Gas sensors, Seed layer, Spray *coating, ZnO nanowires.*