World Academy of Science, Engineering and Technology
International Journal of Materials and Metallurgical Engineering
Vol:12, No:01, 2018

Effect of Al on Glancing Angle Deposition Synthesized In_2O_3 Nanocolumn for Photodetector Application

Authors : Chitralekha Ngangbam, Aniruddha Mondal, Naorem Khelchand Singh

Abstract : Aluminium (Al) doped In2O3 (Indium Oxide) nanocolumn array was synthesized by glancing angle deposition (GLAD) technique on Si (n-type) substrate for photodetector application. The sample was characterized by scanning electron microscopy (SEM). The average diameter of the nanocolumn was calculated from the top view of the SEM image and found to be ~80 nm. The length of the nanocolumn (~500 nm) was calculated from cross sectional SEM image and it shows that the nanocolumns are perpendicular to the substrate. The EDX analysis confirmed the presence of Al (Aluminium), In (Indium), O (Oxygen) elements in the samples. The XRD patterns of the Al-doped In2O3 nanocolumn show the presence of different phases of the Al doped In2O3 nanocolumn i.e. (222) and (622). Three different peaks were observed from the PL analysis of Al doped In2O3 nanocolumn at 365 nm, 415 nm and 435 nm respectively. The peak at PL emission at 365 nm can be attributed to the near band gap transition of In2O3 whereas the peaks at 415 nm and 435 nm can be attributed to the trap state emissions due to oxygen vacancies and oxygen–indium vacancy centre in Al doped In2O3 nanocolumn. The current-voltage (I–V) characteristics of the Al doped In2O3 nanocolumn based detector was measured through the Au Schottky contact. The devices were then examined under the halogen light (20 W) illumination for photocurrent measurement. The Al-doped In2O3 nanocolumn based optical detector showed high conductivity and low turn on voltage at 0.69 V under white light illumination. A maximum photoresponsivity of 82 A/W at 380 nm was observed for the device. The device shows a high internal gain of ~267 at UV region (380 nm) and ~127 at visible region (760 nm). Also the rise time and fall time for the device at 650 nm is 0.15 and 0.16 sec respectively which makes it suitable for fast response detector.

Keywords : glancing angle deposition, nanocolumn, semiconductor, photodetector, indium oxide
Conference Title : ICNMS 2018 : International Conference on Nanotechnology and Materials Sciences
Conference Location : Zurich, Switzerland
Conference Dates : January 15-16, 2018