Structural and impedance spectroscopy study of Al-doped ZnO nanorods grown by sol-gel method

Abstract

Purpose – The purpose of this paper is to investigate the electrical transport mechanism of the Al-doped ZnO nanorods at different temperatures by employing impedance spectroscopy.
Design/methodology/approach – Al-doped ZnO nanorods were grown on silicon substrate using step sol-gel method. For the seed solution preparation Zinc acetate dihydrate, 2 methoxyethanol, monoethanolamine and aluminum nitrite nano-hydrate were used as a solute, solvent, stabilizer and dopant, respectively. Prior to the deposition, P-type Si (100) wafer was cut into pieces of 1 cm £ 2 cm. The samples were then cleaned in an ultrasonic bath with acetone, ethanol, and de-ionized (DI) water for 5 min. The prepared seed solution was coated on silicon substrate using spin coater at spinning speed of 3000 rpm for 30 s and then dried at 2508C for 10 min followed by annealing at 5508C for 1 h. The hydrothermal growth was carried out in a solution of zinc nitrate hexahydrate (0.025M), Hexamethyltetramine (0.025M) in DI water.
Findings – Al-doped ZnO nanorods were characterized using scanning electron microscope (SEM), X-ray diffraction (XRD) and impedance spectroscopy. The impedance measurements were carried out at various temperatures (1008C-3258C). The impedance results showed that temperature has great influence on the impedance; the impedance value decreased as the temperature increased. This decrement is attributed to the increase of the mobility of the defects, especially the oxygen vacancies. The surface morphology of the samples was measured by SEM and X-ray diffraction. The SEM images show that the high density of Al-doped ZnO nanorods covers the silicon substrate, whereas the XRD pattern shows the (002) crystal orientation.
Originality/value – This paper demonstrates the electron transport mechanism of Al-doped ZnO nanorods, at different temperatures, to understand the charge transport model.