Effect of hydroxylamine hydrochloride on the floral decoration of zinc oxide synthesized by solution method

Abstract

Effect of the structure-directing agent on the floral (depicting flower) morphological variation of ZnO is systematically studied and presented here. Flowery decorated (resembling flower) Zinc oxide structure composed of hexagonal nanorods (sharp tips and wider bases) was synthesized at 90 ‘C using Zinc acetate dihydrate and sodium hydroxide at various concentrations ofhydroxylainine hydrochloride for 12 h by solution method.

Single crystalline nature with the wurtzite hexagonal phase remained unaltered with increasing concentration of hydroxylamine hydrochloride while the morphology changes from nanorod to plate like structure. Photoelectron spectroscopic measurement presented spectra close to the standard bulk ZnO, with an O ls peak composed of surface adsorbed O-H group, O_{2-} in the oxygen vacancies on ZnO structure and ZnO. At higher concentration (0.8 M). surface adsorbed O-H group increases while other component decreases because of the changes in the nucleation and surface energy. Results clearly indicate that hydroxylamine hydrochloride works as a structure-directing agent without affecting other properties.

l. Introduction

Controlling the shape and size of the nanocrystalline materials according to ones’ desire is a key challenge in current nanoscience research. Intensified efforts are being put on the control of size, shape and dimensionality of nanocrystalline materials because of their novel unexplored properties and their technical importance [l~4]. Variety of ZnO nanostructures such as nanowires, nanobelts, nanobridgcs, nanonails, nanoribbons, nanorods, nanotubes, and whiskers are reported in the literature. These structures are synthesized by various techniques like. metal organic chemical vapour deposition (MOCVD), spray pyrolysis, ion beam- assisted deposition. laser-ablation. sputter deposition. template- assisted growth and chemical vapour deposition. etc. [5-l4]. However, reports on the structure-directing agents are rare. The literature survey presented below clearly indicates that there is a

need to investigate the effects of directing agents and understand how they can control the morphology of these nanostructures.

Previously, Zhang et al. presented the synthesis of flower-shaped, snow flakes, prism, prickly spheres and rod-like morphologies using the $Zn(OH)_4^{2-}$ or $Zn(NH3)_4^{2-}$ precursor solutions (prepared in various solvents such as n-heptane. ethanol, water, etc.) at 180 “C for l3h in a Teflon-lined autoclave [15]. Gao et at. reported the formation of flower-like ZnO nanostructures on silicon substrate at 95"C by the thermolysis of ehthylenediaminc—zinc complex with the assistance of hexamethylcnetetramine in a laboratory pyrex glass bottle with polypropylene autoclavable screw caps with the filling ratio of 80% [l6]. Umetsu et al. reported the synthesis of ZnO nanostructures with the assistance of artificial peptides. They reported that the peptides can assist in the homogeneous assembly of ZnO nanoparticles into unique flower-like morphologies [I7]. Hochepied et al. also synthesized the flower-shaped pompom-like particles from temperature-driven ammonia decomplexation at 85 “C in a water-jacketed thermostat reactor, stirred mechanically by a four-blade propeller at 500 rpm [I8]. Yang and co-workers presented the synthesis of flower-shaped, disk-like and dumbbell-like