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Comparison of ZnMgO/ZnO core-shell structures with ZnO nanorods for UV detection

A comparison of the crystal and optical properties of ZnMgO/ZnO co-axial core-shell (CS) nanostructures and ZnO nanorods (NRs) towards enhanced ultraviolet (UV) detection is reported. ZnMgO/ZnO CS structures were grown on p-Si substrates using a horizontal First-Nano 3000 MOCVD system. Prior to growth of the CS, a ZnO thin film was grown at 300°C at a constant pressure of 70 Torrs for 20 minutes. The temperature was raised to 650°C and the pressure was decreased to 4 Torrs for the growth of the ZnMgO core structure seeded on the thin film using a ratio of 1/10 of DEZn/Cp2Mg, Cp2Mg (Bis(cyclopentadienyl)magnesium) being the Mg source. A 10 min drive-in of MgO using 200 sccm of Cp2Mg and 500 sccm of N2O was performed to increase the Mg mole fraction. The growth was followed by Mg activation at 800°C for 10 minutes in nitrogen ambient. Finally, the ZnO shell was grown at 300°C using similar parameters used during the growth of the seed layer. ZnO NRs were grown on flexible transparency and p-Sisubstrates via hydrothermal synthesis performed in two steps. Initially, 90 mg of zinc acetate and 120 mg of potassium hydroxide were dissolved in 50 ml of methanol and then constantly stirred for 5 min at 60˚C. Using this zinc acetate solution as a seed layer, the samples were spin coated. The epilayer was grown by immersing the samples in an 0.1 M aqueous $Zn(NO_3)_2$ solution and 0.1 M of HMTA at 90°C in a laboratory oven for 1 hour. Finally, NR growth was accomplished in a water bath at 70˚C using an equi-aqueous solution of 25 mM $Zn(NO_3)_2$ and HMTA for 3-7 hours. The crystal structure of the ZnMgO/ZnO CS and ZnO NRs were inspected under X-ray diffraction (XRD) spectroscopy. The CS structures had a c-lattice constant of 5.20Å and 5.186Å, which corresponded to the shell (ZnO) and the core (ZnMgO) with approximately 10% Mg, respectively. The Mg mole fraction was estimated using high resolution energy dispersive X-ray spectroscopy (EDS) carried out under transmission electron microscope (TEM) confirming 8-10% Mg incorporation at the core and 0% Mg incorporation at the shell. In the case of ZnO NRs, the c-lattice constant was estimated to be 5.1923Å. The optical quality of the grown CS structures and ZnO NRs were investigated using photoluminescence (PL) spectroscopy with a 325 nm He-Cd laser at room temperature. Both structures show excitation peaks at 389 nm, 537 nm and 587 nm, which correspond to exciton transition, oxygen vacancies and Zn interstitial states, respectively. These transitions will be investigated in more details and correlated to their performances as UV detectors.

Biography

Mehdi Anwar serves as an Editor of *IEEE Journal of Electron Devices* and has served as an Editor of the *IEEE Transactions on Electron Devices* (2001 - 2010). He is the Guest Editor of an upcoming issue of Optical Engineering. He serves as the conference chair of the international conference on Terahertz Physics, Devices and Systems: Advanced Applications in Industry and Defense of the SPIE Defense, Security and Sensing (2009, 2010, 2011, 2012). He has also chaired the 2006 and 2007 Terahertz Physics, Devices and Systems Conference as part of SPIE's Optics East. He is a SPIE fellow.

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