Microstructural, chemical states and electrical properties of Au/CuO/n-InP heterojunction with a cupric oxide interlayer

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1. Introduction

Among III-V compound semiconductors, explicitly indium phosphide (InP) has gained considerable interest in the fabrication of electronic and optoelectronic device applications such as high-speed metal-insulator-semiconductor field effect transistors (MIS-FETs), microwave devices, ultra high-speed integrated circuits (ICs), laser diodes, photo-detectors and solar cells [1–4]. However, the main drawback of the InP Schottky barrier is its relatively low Schottky barrier height (SBH) (0.40–0.45 eV); as a result there is large reverse leakage current at the interface [5]. The formation of interlayer between metal and semiconductor is best method to increase the effective barrier. This interlayer can act as a tunnelling barrier [5]. Thus, the formation of interlayer in between the metal and semiconductor and explored its detailed electrical properties are a scientific challenging issue. Some research groups have fabricated and studied the electrical characteristics of metal-interlayer-semiconductor (MIS) structures on Si and n-InP substrate. For instance, Ibrahim et al. [7] prepared Al/CuO/p-Si MIS diode by forming CuO nanofilm with spin coating technique and reported that the barrier height (BH) and ideality factor values were 0.64 eV and 2.39 from I-V characteristics, respectively. Cetinkaya et al. [8] synthesized CuO by chemical bath deposition (CBD) and sol-gel methods, and carried out the structural and electrical properties of Au/CuO/p-Si MIS diodes. Menawy et al. [9] prepared the Co/n-CuO/p-Si/Al MIS diode and studied its I-V characteristics in the temperature range 300–390 K. Tombak et al. [10] demonstrated that the electrical properties of Ag/CuO/n-Si MIS diode and reported that the BH and ideality factor values were 0.75 eV and 3.51, respectively. Thapaswani et al. [11] presented the electrical parameters of Au/Ba0.6Sr0.4TiO3/n-InP MIS diode increased as compared to the Au/n-InP Schottky junction (SJ) diode. Padma et al. [12] studied the electrical properties of Au/Fe-ZnO/n-InP MIS structures, and reported that the BH values of MIS structure were increased as compared with that of the Au/n-InP SJ diode. Balaram et al. [13] evaluated the effect of high-k ZrO2 interlayer between Au and n-InP, and reported that the BH values were enhanced for the