J.Natn.Sci.Foundation Sri Lanka 2021 49 (1): 61 - 66
DOI: http://dx.doi.org/10.4038/jnsfr.v49i1.8942

RESEARCH ARTICLE

Effect of pre-surface treatments on p-Cu_2O/Au Schottky junctions

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Submitted: 22 March 2019; Revised: 13 October 2020; Accepted: 23 October 2020

Abstract: Cuprous oxide (Cu_2O) is a suitable semiconducting material for fabrication of low-cost, eco-friendly semiconductor junction devices. Besides the parameterization of the growth conditions of Cu_2O, formation of metal contacts impact the overall performance of these type of devices. The existence of unavoidable dangling bonds and/or dislocated surface atoms could lead to form imperfect contacts with metals, for example in Cu_2O/Au junction devices. Nevertheless, modification of the Cu_2O thin film surfaces prior to make contacts with Au has shown the capability to alter the junction properties. Here we report that, the application of surface treatments; annealing and/or sulphidation on specifically the electrodeposited p-Cu_2O thin film surfaces, where p-Cu_2O thin films were grown in low cupric ion concentrated acetate bath, has influenced the interfacial properties of particular p-Cu_2O/Au Schottky junctions compared to the untreated p-Cu_2O/Au Schottky junction. This has been well-established by the results of SEM and C-V characterizations of p-Cu_2O/Au Schottky junctions. The subsequent annealing and sulphidation of p-Cu_2O thin film surfaces have lowered the built-in potential value by 121 mV compared to the untreated Schottky junction. This result reveals the possibility of employing surface treatments on electrodeposited Cu_2O thin films in fabrication of high efficient Cu_2O based junction devices.

Keywords: Annealing, cuprous oxide, electrodeposition, pre-treatments, Schottky junction, sulphidation.

INTRODUCTION

As a feasible, eco-friendly, affordable, photosensitive semiconductor, Cu_2O is found in applications in photovoltaics (Camacho-Espinosa *et al.*, 2018), photocatalysts (Singh *et al.*, 2018), water splitting systems (Ma *et al.*, 2015), gas sensors (Jayasingha *et al.*, 2017), glucose sensors (Yu *et al.*, 2018), supercapacitors (Wang *et al.*, 2018) and magnetic storage devices (Hu *et al.*, 2016).

It is known that extracting output of a semiconductor through a proper metallic contact enhances the device performance. Therefore, it is useful to have knowledge on how a semiconductor works with a metal interface. Basically, the work functions of a semiconductor and the metal in contact tell whether it is an ohmic or Schottky junction (Sze & Ng, 2006). The Schottky nature of Cu_2O/metal junction is useful in fabrication of Schottky barrier solar cells and making ohmic contact is important in other type of solar cell configurations (i.e., homo-, hetero- or multi-junctions), transistors, Peltier modules etc.

In 1979s, Olsen *et al.* have reported the theoretical and experimental results related to Cu_2O in contact with variety of metals such as, Yb, Mg, Mn, Al, Cu, Cr and Au (Olsen *et al.*, 1979). Practically, the reported ohmic nature of the Cu_2O/Au contact is not observed in electrodeposited Cu_2O thin films (Kafi *et al.*, 2018a; b). However, the other attractive properties of electrodeposition method such as ability to grow Cu_2O on different substrates (Abdelfatah *et al.*, 2015; Mohra *et al.*, 2016; Bouderbala*et al.*, 2018) or different orders in a cell configurations (Jayathileke *et al.*, 2008; Wijesundera *et al.*, 2016) and uses of Au contact such as, low resistivity, high mobility and durability (Mayer, 1984) tell us the importance of formation of low resistive p-Cu_2O/Au junctions.

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