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Comparison of interface properties of post-treated p-Cu_2O/Au Schottky junctions

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Cu_2O is one of the eco-friendly affordable semiconductor materials that can be used in wide range of semiconductor junction devices such as solar cells, gas sensors, and microwave and optoelectronic devices. Semiconductor surface reconstruction and modification changes the surface properties, which can be used to optimize the overall junction performance. In this study, we studied interface properties of p-Cu_2O thin films in contact with gold, where Cu_2O films were deposited in aqueous acetate electrolyte bath and the surface of the films were subsequently modified by annealing and/or surface passivation. p-Cu_2O thin films were potentiostatically electrodeposited in a 0.1 M sodium acetate and 0.001M cupric acetate aqueous electrolytic solution,with the pH value at 7.2 in p-Cu_2O film deposition bath, at previously determined growth conditions. In order to study the effect of annealing and surface passivation of p-Cu_2O thin films, one set of as-grown p-Cu_2O thin films was annealed at 175°C for 10 minutes, while another identical set of as-grown p-Cu_2O thin films was exposed to 20 vol% of Ammonium Sulfide solution for 8 s at 27°C. The ammonium surface treatment was carried out for some of the above post annealed p-Cu_2O thin films. Au was sputtered on the p-Cu_2O thin films to fabricate Schottky junctions: as-grown p-Cu_2O/Au, annealed p-Cu_2O/Au, surface passivated p-Cu_2O/Au and annealed+surface passivated p-Cu_2O/Au. Mott-Schottky analysis was employed for the investigation of interface properties of Schottky junctions. Results revealed that the post-treated p-Cu_2O thin films in contact with Au modify the interface properties. This result is established by the values obtained from the built-in potential, doping density, minority carrier concentration, electron affinity and work function of the Cu_2O films. Further, the built-in potential relative to the Fermi level of Au has diminished for the surface treated p-Cu_2O thin films compared to the as-grown p-Cu_2O thin films. This result is an evident for the lowering of the relative band edge position of Cu_2O due to the surface reconstruction and/or modification of the interface surface layer. The reported result will be very useful in fabrication of highly efficient Cu_2O based junction devices.

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