Enhanced performance of Sb2S3 mesoscopic sensitized solar cells employing TiO2:Nb compact layer

Abstract

This paper reports on the enhancement of charge transport and recombination by niobium doped compact layers of TiO_2 in a solar cell with Sb_2S_3 absorber layer by characterizing both thin films of TiO_2:Nb and working solar cell devices with the layer stack FTO/cp-TiO_2:Nb/mp-TiO_2/Sb_2S_3/P3HT/MoO_x/Ag. The electron transport layers of TiO_2 doped with 0.14 and 0.27 at.% Nb were prepared by spin coating and have no structural change as determined from the analysis of GIXRD spectra. SEM images show thin pin hole free layers of the cp-TiO_2:Nb on FTO crystals that are agglomerates of particles. Analysis of the current–voltage curves of the solar cells with Sb_2S_3 as the absorber material showed increased short-circuit current, fill factor and power conversion efficiency from 1.3 to 1.7%. The enhancement of the device performance is attributed to substitution of Ti ions with Nb ions in the TiO_2 resulting in a change in the band alignment of the solar cells with Nb content. This results in increase in charge recombination resistance in the Sb_2S_3 layer as determined from the analysis of the impedance spectroscopy measurements.

Authors.

Victor Odari, Robinson Musembi & Julius Mwabora