***Abstract No: 169*** ***Physical Sciences***

# THICKNESS CONTROLLED FABRICATION OF $Sb_2S_3$ PLANAR STRUCTURE ENHANCED LIGHT HARVESTING AND CHARGE COLLECTION EFFICIENCY

**M.A. Farhana and J. Bandara***

*National Institute of Fundamental Studies, Kandy, Sri Lanka*
**jayasundera.ba@nifs.ac.lk*

Utilization of semiconductors as a light absorbing material has recently been receiving much attention. Among the range of investigated semiconductors, antimony sulfide ($Sb_2S_3$) is appealing as a promising light absorber due to its suitable bandgap (1.5 - 1.7 eV), one dimensional crystal structure and non-toxic constituents. Among a number of methods available, spin coating is known as the simplest technique to fabricate $Sb_2S_3$ thin films. In this investigation, the thickness of the $Sb_2S_3$ light harvesting layer was optimized by varying the spin coating conditions. Different $Sb_2S_3$ photoanodes were fabricated on the $TiO_2$ compact layer/FTO substrates by spinning the $Sb_2S_3$ precursor solution of antimony chloride and thiourea (2:3) in 2-methoxyethanol at 3000, 4000, 5000 and 6000 rpm for 30 s. The devices, fabricated with the configuration of FTO/compact $TiO_2$/$Sb_2S_3$/P3HT/Ag, showed an increase of solar cell performance with an increase of the spinning rate of the $Sb_2S_3$ precursor solution up to 5000 rpm. The thickness of $Sb_2S_3$ film, which was fabricated at 5000 rpm was ~ 265 nm, showed the highest power conversion efficiency of 4.01% with 619.2 mV as open circuit voltage, 14.05 mA $cm^{-2}$ as short circuit current and 46.1% as a fill factor. The IPCE measurements were in good agreement with the *I-V* performance of the devices. Generally, the morphology of the films has no significant changes with the spinning speed. However, the thicknesses of $Sb_2S_3$ films were decreased by increasing spinning speed, which was examined by UV-Vis absorption spectra of $Sb_2S_3$ films. Therefore, the thickness of $Sb_2S_3$ film should be one of the critical factors that highly affects the performance of $Sb_2S_3$ solar cell devices. Herein, the performance of the $Sb_2S_3$ based solar cell was improved upon changing the thickness of $Sb_2S_3$ film based on spinning speed.

*Financial assistance from the National Research Council* (*Grant No. 18-005*) *is acknowledged.*

**Keywords:** Light absorber, Planar structure, Spinning speed and Thickness