Numerical study of nSi and nSiGe solar cells: Emerging microstructure nSiGe cell achieved the highest 8.55% efficiency

ABSTRACT

This paper reports about the comparative study of nSi and nSiGe microstructure materials opto-electrical energy conversion prospect. The significance of nSiGe thin active laye in organic-inorganic heterojunction (HJ) solar cell efficiency progression is illustrated. Transparent and carrier selective top contact purposes p-type un-doped organic materials are promising for low processing cost n-Si HJ solar cell. Near infrared band absorption enrichment by Ge inclusion in n-Si thin active layer is a new design approach. p-PTAA/n-Si PV device modelling and it electrical properties are investigated by using SCAPS simulator. Thin Si active layer solar cell is commercially important. However, thin layer absorption related technological shortcoming overcoming approaches 10% Ge content impact is studied in this work. Moreover, SiO_2 nanomaterial passivated p-PTAA/SiO_2/n-SiGe and p-PTAA/SiO_2/n-Si models active layer thickness and operating temperature effects have also been studied. The current-voltage (J-V) characteristics analysis is realized that nSiGe cell is potential for the progression of current density and efficiency. SiO_2 nanomaterial passivated 3 µm SiGe microstructure cell is realized promising to increase 48.1 mA/cm^2 of current density. The highest 8.55% efficiency is achieved for 2 nm SiO_2 passivation and 20 nm of PTAA emitter.