INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Programme of Study : Ph.D.

Thesis Title:
Fabrication and Studies of a-Si:H Thin Films and Single Side c-Si(n)/a-Si:H(p) Heterojunction Solar Cells

Name of Thesis Supervisor(s) : Prof. Pratima Agarwal

Thesis Submitted to the Department/ Center : Physics

Date of completion of Thesis Viva-Voce Exam : 30.04.2019

Key words for description of Thesis Work : a-Si:H thin films, c-Si/a-Si:H Heterojunction Solar cells.

SHORT ABSTRACT

In this thesis, one sided c-Si/a-Si:H heterojunction solar cells (*Ag/Al/c-Si(n)/a-Si:H(i)/a-Si:H(p)/ITO/Ag*) with open circuit voltage (V_{oc}) as high as 711 mV and efficiency (η) of 17.3% were fabricated on double side polished n- type c-Si wafer by RFPECVD technique in multi-chamber system. In order to improve the device performance, the influence of hydrogen plasma treatment and hydrogen flow rate on the microstructural, optical and electrical properties of intrinsic and doped a-Si:H films have been studied. The evolution of nanocrystalline Si phase due to intermittent hydrogen plasma treatment of a-Si:H films was studied through Spectroscopic ellipsometry (SE), Raman and FTIR. The growth of nanocrystalline phase was enhanced due to etching of weak Si-Si and Si-Hydrogen bonds and reduction in bonding disorder during hydrogen plasma. High deposition rate nc-Si:H films have been achieved at low substrate temperature by hydrogen plasma treatment. For doped a-Si:H films, a series of a-Si:H(p) and a-Si:H(n) films were deposited using RFPECVD technique by varying the hydrogen flow rate in the range of 30-70 SCCM and 30-80 SCCM respectively. It was observed that microstructure of a-Si:H(p) and a-Si:H(n) films changed from amorphous to nano crystalline phase by increasing hydrogen flow rate during film growth. Indium Tin Oxide (ITO) thin films were deposited with varying deposition temperature of 50-200 ^{o}C by RF Sputtering. These ITO films used as transparent conducting and anti-reflection layer in solar cells. Finally, solar cells were fabricated with optimized parameters for best quality a-Si:H films. Properties of interfaces and each layer of solar cells were studied with SE measurements. A systematic investigation has been carried out to study the influence of diborane flow rate and thickness of i and p-layers to identify the role of doping and thickness of a-Si:H(p) layer on the performance of c-Si/a-Si:H heterojunction solar cells. EQE measurements were carried out on the cells with and without external reverse bias to study interface properties and significance of electric field at interface. High open circuit voltage and efficiency were achieved for single side c-Si/a-Si:H heterojunction solar cells, which are highest among those reported so far for single side c-Si/a-Si:H heterojunction cells.