Abstract

Photovoltaic conversion is the direct conversion of sunlight into electricity. Amorphous silicon thin film and amorphous silicon solar cells are getting importance due to its advantages over crystalline silicon solar cells. The main advantages are simple technology and inexpensive because deposition temperature used below 300 ^{0}C. However, in crystalline silicon solar cells temperature is more than 1000^{0}C used, for a given layer thickness amorphous silicon thin film absorb much more light energy than crystalline silicon (2.5 times more), less material required for amorphous films, lighter weight, less expensive and can be deposited on wide range of substrates.

In this study, PECVD technique is used for deposition of p (p-doped), i (intrinsic) and n (n-doped) layers of amorphous and micro/nano-crystalline silicon films. These solar cells are basically consisting of amorphous silicon layers of p, i and n on a TCO coated glass substrates. In this *i* is absorber layer in which sun light absorb, electrons holes pairs generates, n-type layer conduct electrons, p-type conduct holes due to this concentration gradient and flow of electrons electric current produced. It is important to understand the electrical transport properties in these different deposited layers for preparation of efficient solar cells. Therefore, this study focused on electrical transport properties of amorphous & micro/nano-crystalline silicon thin films for solar cell applications.

In this study, set of amorphous and micro/nano-crystalline silicon doped (p & n) and un-doped layers are considered for estimation of electrical transport behaviors of these layers. Photo and dark dc electrical conductivity is measured as temperature dependent and activation energy is estimated. The main focus of the present investigation is to understand conduction mechanism near Fermi level which is known as 3D variable range hopping and follow Mott model of conductivity in silicon based thin films. Usually variable range hopping conduction occurs at very low temperature. In disordered semiconductors, low temperature electrical transport occurs via localized electronic states which depend on the DOS shape, Fermi level position and temperature. We have also calculated the conductivity pre-factors σ_0, σ_{00} ($\Omega^{-1}cm^{-1}$) and $T_0^{1/4}$ (Temperature in K) and there slopes for density of states calculation near Fermi level.

It is observed that density of states near Fermi level changes with doping and activation energy varies for doped silicon thin films. Density of state increases with both types (p & n) of doping. Activation energy, conductivity pre-factors, DOS (Density of state) of different doped and un-doped amorphous & micro/nano-crystalline silicon thin films are estimated by measuring temperature dependent dark conductivity.