Abstract

The PV technology is free from the production of pollutants during operation and thus contribute in the reduction of global warming. The rapid decrease in the photovoltaic (PV) module cost and the escalation in the price of petrochemical fuels have encouraged the diffusion of PV systems that, in the past, were considered attractive only for special applications in remote off-grid areas. The performance of a PV module largely depends on the availability of solar radiation and on the conversion efficiency; these important features are affected by many physical parameters like the site latitude, the typical weather conditions, the panel tilt and azimuth angles, the air temperature, the wind speed, the temperature of the surrounding surfaces, the obstruction and shadow effects, the electrical load, etc. Since a solar panel is exposed to sunlight all day long, its temperature rises due to heating up. Temperature is an important passive factor which lowers down the performance of the solar cell/module during operation. The solar cell performance is determined by its parameters viz. open circuit voltage (V_{OC}), short circuit current (I_{SC}), fill factor (FF) and efficiency (η). In this work, the temperature dependence of the performance of solar cells has been investigated in the temperature range 298-343K. Silicon solar cells materials of three types i.e mono-crystalline, poly-crystalline (c-Si) and thin film amorphous (a-Si) have been considered. Reverse saturation current density (J_O) is an important diode parameter which controls the change in performance parameters with temperature. The maximum achievable V_{OC}, J_{SC}, FF and η of silicon solar cells are calculated for AM1.5G solar spectra and are compared with the theoretical data and experimentally obtained results. The rate of change of the performance parameters w.r.t temperature i.e. dJ_{sc}/dT , dV_{oc}/dT , dFF/dT and $d\eta/dT$ have been calculated theoretically and are compared with the results obtained experimentally.

Keywords: open circuit voltage, short circuit current, reverse saturation current, fill factor.