A Comparative Study for a Building Integrated Semitransparent Photovoltaic Thermal (BISPVT) System Integrated to Roof with and without Duct

Aditya Seal

Centre for Energy Studies, Indian Institute of Technology Delhi, India

Abstract

In this paper, a study has been carried out to evaluate annual energy and exergy of a building integrated semitransparent photovoltaic thermal (BISPVT) system integrated to the roof of a building with and without duct. Comparisons of annual energy and exergy have been done by considering six different photovoltaic (PV) modules installed on the roof for cold climatic city of Srinagar, India. It is observed that the annual overall thermal energy is maximum for heterojunction with thin layer (HIT) and minimum for amorphous silicon (a-Si) for both with and without duct cases. It is also found that the annual overall exergy in HIT is 643 kWh and 610 kWh for both with and without duct cases, respectively. A lot of experimental and theoretical studies have been done on building integrated photovoltaic thermal (BIPVT) system and it is found that integration of PV modules on the roof of a building produces a large amount of electrical energy as compared to integration of PV module on the facade. Thus BIPVT systems on roof save annual building electrical energy. Li et al. found the annual building electricity saving of 1203 MWh by using semitransparent PV module. Sadineni et al. saved 3.19 kWp of annual electrical energy by installing a system on the south facing roof of home in Las Vegas. System performance and system efficiency for a PV module installed on the roof and facade for a Samsung Institute of Engineering and Construction Technology (SIECT), Gihung, were evaluated by Yoo et al. They observed that the BIPV system on the building provides about 10% of the required electricity for a typical day. Song et al

suggested that the PV modules installed at 30 °C performed better than vertical PV module in terms of annual power output. Agrawal and Tiwari developed analytical expression for room air temperature for an opaque-type BIPVT system mounted on the rooftop of a building. They concluded that for a constant mass flow rate of air, room temperature is higher in series combination than any other type of combination of BIPVT system. In all researches, mono crystalline, poly crystalline silicon (mor p-Si), and amorphous silicon (a-Si) modules have been considered. But in this paper alternative PV technologies like cadmium telluride (CdTe), copper indium gallium diselenide (CIGS), and a heterojunction comprised of a thin a-Si PV cell on top of a c-Si cell (HIT-hetrojunction with intrinsic thin layer) have also been considered for the analysis. In this paper, a comparative study has been carried out to evaluate annual energy and exergy of a building integrated semitransparent photovoltaic thermal (BISPVT) system integrated to the roof of a building with and without duct, for different types of PV modules. Table 1 shows the module's efficiency ($\eta r,PV,m$) under Standard Test Conditions (STC) and temperature coefficient ($\beta r,PV,m$) for the selected PV modules.