

A review on various configurations of hybrid concentrator photovoltaic and thermoelectric generator system

ABSTRACT

Concentrator photovoltaics (CPV) is of much intrigue among all photovoltaic (PV) technologies because it replaces the expensive PV cell material with cheaper optical concentrators and occupies less land area as compared with conventional PV technology. However, it is challenging to handle the elevated operating temperature of CPV cells, which is reported capable of deteriorating the lifetime and power conversion efficiency of the CPV system. The integration of a CPV system with thermoelectric generators (TEG) provides a state-of-the-art hybrid design for improving energy harnessing from both electrical and thermal outputs, which also implies a better utilization of solar energy. This review article delineates various integration options of the CPV-TEG system and up-to-date developments of different configurations of hybrid CPV-TEG system including CPV-TEG with a spectral beam splitter, CPV/thermal-TEG, and CPV-TEG with phase changing materials. The numerical simulation and experimental studies on various configurations of hybrid CPV-TEG systems are summarized and outlined in this review. It has been found that the integrated CPV-TEG based solar thermal systems have higher electrical and thermal performances than that of non-concentrated PV-TEG systems. Finally, some recommendations are made for the future development of CPV-TEG systems.

Keyword: Concentrator photovoltaics; Thermoelectric generators; Fresnel lens; Spectral beam splitter; Nanofluids; Phase change materials