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Investigation of the design aspects on the performance of a LCPV system

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Abstract content
 (Max 300 words)

The benefit of concentrating sunlight onto solar cells is that expensive semiconductor solar cell material can be reduced and replaced with relatively inexpensive optical elements, which has the potential to reduce the levelised cost of solar energy.

In low concentration photovoltaics (LCPV), solar cells are subjected to higher irradiance levels. Three interrelated subsystems, viz., optical, electrical and the thermal subsystems are generally considered when improving the energy performance and module design of a LCPV system. These subsystems need to be optimised with respect to each other in order for the module's electrical performance to be maximised.

Design considerations for the optical subsystem include the optimisation of aperture area while considering the module temperature and maintaining a uniform illumination intensity across the solar cells. The electrical power output of a LCPV module is dependent on the irradiance and the design of the interrelated subsystems. Using a mathematical model that satisfied a predetermined set of boundary conditions a LCPV module was designed and constructed with a geometric concentration ratio of 5.2 X. Optical characterisation includes evaluation of the intensity profiles produced by the optical reflector element. An electrical evaluation was also conducted by measuring the current voltage (I-V) characteristics obtained under one-sun as well as under solar concentration on a cloudless day.

This paper discusses the design aspects and characterisation of the optical and electrical subsystem of an experimental LCPV concentrator module.

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