OPTIMISED CONCENTRATOR FOR THE SOLAR PHOTONIC OPTOELECTRONIC TRANSFORMER: FIRST OPTIMISATION STAGE

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ABSTRACT

Collecting and storing solar energy will be a key part of efficient renewable technologies for buildings of the future, particularly in the Middle East. This paper presents the topic of improved properties of optical concentrators to achieve increased solar energy gain. The Solar Photonic Optoelectronic Transformer (SPOT) system is one of the components of the SolarBrane, a Building Integrated Photovoltaic (BIPV) system developed by SolarEmpower Ltd. The SPOT system employs a dielectric totally internally reflecting concentrator (DTIRC) to increase the collection efficiency of the sun's rays and reduce the amount of photovoltaic (PV) material used. In this paper, an optimised DTIRC design for the SPOT system, based on the maximum concentration method (MCM) is discussed. The impact of varying input parameters on the geometrical concentration and on the size of the concentrator are indicated. Next, the most important geometrical properties of the optimised DTIRC design are explained and compared to a DTIRC based on the phase conserving method (PCM). The results obtained from simulations in MATLAB show that the MCM offers higher geometrical concentration gains at the cost of increasing the concentrator size. The importance of the design for practical applications are also discussed.

KEY WORDS: Solar energy, solar concentrator, dielectric totally internally reflecting concentrator, phase conserving method, maximum concentration method