Embossed fins for improved PV module efficiency - A CFD study

ABSTRACT

The escalating global demand for renewable energy has propelled the adoption of Solar Photovoltaic (PV) panels. However, the efficiency of these panels is often compromised by elevated operating temperatures. This study aims to systematically investigate the influence of embossed fins on the thermal performance of solar PV modules using Computational Fluid Dynamics (CFD) simulations. The study also delves into the underlying mechanisms by which emboss geometries modulate fluid flow and induce turbulence, thereby affecting convective heat transfer efficiency. The simulations, when validated against experimental data, exhibited a high accuracy with a maximum difference of 4.45%. Results indicate that the triangular emboss fin is the most effective in enhancing heat transfer by convection, achieving the lowest average PV module surface temperature of 41.78 °C. This study gives vital insights on the impact of emboss fin in maximizing the thermal efficiency of solar PV systems, hence presenting a roadmap for design advances in PV module cooling methods.