

## Recent progresses and challenges in cooling techniques of concentrated photovoltaic thermal system: A review with special treatment on phase change materials (PCMs) based cooling

*M. Arif Fikri<sup>a</sup>, M. Samykano<sup>a</sup>, A. K. Pandey<sup>b,c</sup>, K. Kadirgama<sup>d</sup>, R. Reji Kumar<sup>a</sup>, Jeyraj Selvaraj<sup>e</sup>, Nasrudin Abd Rahime, V. V. Tyagif, Kamal Sharma<sup>g</sup>, R. Saidur<sup>b</sup>*

<sup>a</sup> College of Engineering, University Malaysia Pahang, Lebuhraya Tun Razak, 26300, Gambang, Kuantan, Pahang, Malaysia

<sup>b</sup> Research Centre for Nano-Materials and Energy Technology (RCNMET), School of Engineering and Technology, Sunway University, No. 5, Jalan Universiti, Bandar Sunway, Petaling Jaya, 47500, Selangor Darul Ehsan, Malaysia

<sup>c</sup> Center for Transdisciplinary Research (CFTR), Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, India

<sup>d</sup> Faculty of Mechanical & Automotive Engineering Technology, Universiti Malaysia Pahang, 26600, Pekan, Pahang, Malaysia

<sup>e</sup> Higher Institution Centre of Excellence (HiCoE), UM Power Energy Dedicated Advanced Centre (UMPEDAC), Level 4, Wisma R&D, University of Malaya, Jalan Pantai Baharu, 59990, Kuala Lumpur, Malaysia

<sup>f</sup> School of Energy Management, Shri Mata Vaishno Devi University, Katra, 182320, J&K, India

<sup>g</sup> Department of Mechanical Engineering, Institute of Engineering and Technology, GLA University, Mathura, 281406, India

### ABSTRACT

Concentrated Photovoltaic (CPV) system is one of the efficient and economical photovoltaics (PV) technologies. The fundamental principle of using CPV system is a substitution of expensive cell area with inexpensive optics. Concentrating the solar radiation on small areas enhances the power output. However, operating at high temperatures can potentially impair their life span and performance. Thus, cooling medium plays a crucial role in refining the CPV system's efficiency. The integration of the CPV system with Phase change materials (PCMs) provides a state-of-the-art hybrid design for both thermal and electrical outputs, suggesting a better utilization of solar energy. Nano-enhanced Phase Change Materials (NePCMs) were demonstrated to be the best combination for optimal behavior, such as storing and releasing energy quicker during the phase transition process without help from external systems. Key objective of this review article is to present the latest works and technical challenges on the application of PCMs and NePCMs in Concentrated Photovoltaic Thermal (CPVT) as cooling and thermal energy storage mediums to improve PV cell efficiency. This review leads to the current gaps in the research and recommends future work on developing new PCMs, and NePCMs integrated CPV systems for improved performance, life span and economic feasibility.

### KEYWORDS

Concentrated photovoltaic thermal system (CPVT); Concentration ratio; Cooling techniques; Nano-enhanced phase change materials; Phase change materials; Thermal regulation medium

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