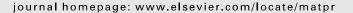


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# Influence of physical characteristics of graphene/Al<sub>2</sub>O<sub>3</sub> composites employing nano particles based organic phase changing materials

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## ABSTRACT

In the field of energy conservation and management, PCMs are increasingly being used to store latent heat. PCMs have been infused with nanoparticles to enhance their thermal conductivity. This work presents the results of a study on the thermo-physical characteristics of an  $Al_2O_3$ -Graphene ( $Al_2O_3$ : Gr) binary composite (1 wt%  $Al_2O_3$ :0.5, 1, 1.5, and 2 wt% of Graphene (Gr)) with Paraffin wax (PW) as a surfactant. Thermo-gravimetric analyzer (TGA), Thermal property analyzer (TEMPOS), and UV–VIS spectrometer (UV–VIS) were all employed to characterize the materials. The latent heat capability of Paraffin Wax/ $Al_2O_3$  Graphene binary composites increased by 8.62 % and 10.02 %, as compared to Phase change material.  $Al_2O_3$ -1.0 and  $Al_2O_3$ -1.0% PCMs exhibit thermal conductivities that are 130 and 180 %more than base paraffin wax. According to the Fourier Transform Infrared spectra, there was no chemical connection between the paraffin wax and nanoparticles. Thermal stability was raised by including  $Al_2O_3$ -Graphene particles into the paraffin wax matrix, according to TGA measurements. The produced composite's light transmission was lowered by 60.2% compared to the base PW, resulting in higher light absorption and, as a result, increased photothermal transformation. Thermal conductivity and enthalpy of the composite generate a great choice of solar photovoltaic thermal and TES systems. Copyright © 2023 Elsevier Ltd. All rights reserved.

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## 1. Introduction

Climate change and energy security are two of the most pressing challenges in the world today, and they are intertwined [1]. Carbon dioxide emissions, which are a key contributor to climate change despite the fact that fossil fuels are rapidly decreasing, remain a significant part of the global energy system [2–4]. Thermal energy storage systems (TES) are a crucial tool for reducing our dependence on fossil fuels and enabling more efficient, ecologically friendly, and cost-effective long-term energy storage when excess heat from renewable energy source is utilised [5,6]. There has been a lot of buzz about the possibilities for energy storage

tory of excellent thermal stability, are now the standard for energy storage [7,8]. It is possible to store and discharge enormous amounts of energy with some PCMs. Certain drawbacks will occur in the use of PCMs, such as their poor thermal conductivity (TC) and low thermo-physical properties (TPP) [9–11]. The TC of PCMs can only be improved by incorporating nanoparticles into them. The surface area to volume ratio can be increased by using nanoparticles, as well as the solidification and melting rates reduced [12,13].

in PCMs recently. Organometallic, inorganic, and eutectic PCMs exist in the PCM family tree, Organic PCMs, which have a long his-

Nanoparticles with high conductivity that are scattered in the PCM have the potential to improve thermal conductivity and maintain thermal efficiency [14]. They've been regarded as some of the most promising energy storage technologies to date because of

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