Materials Today: Proceedings 77 (2023) 448–454

Contents lists available at ScienceDirect

Materials Today: Proceedings

journal homepage: www.elsevier.com/locate/matpr

Influence of physical characteristics of graphene/Al_2O_3 composites employing nano particles based organic phase changing materials

D. Saravanakkumar [a,*], Sanath Kumar Tulasi [b], Bipin Kumar Srivastava [c], Nellore Manoj Kumar [d], N. Gayatri Devi [e], D.T. Sakhare [f]

[a] PG and Research Department of Physics, Thiagarajar College, Madurai 625009, Tamil Nadu, India
[b] Department of Electronics & Communications Engineering, Koneru Lakshmaiah Education Foundation,Vaddeswaram 522302, Andhra Pradesh, India
[c] Department of Applied Sciences, Galgotias College of Engineering and Technology, Greater Noida 201306, Uttar Pradesh, India
[d] Department of Physics, SCSVMV Deemed University, Enathur, 631561 Kanchipuram, India
[e] Department of Chemistry, Ch.S.D.St.Theresa's College for Women (A), Eluru 530003, Andhra Pradesh, India
[f] Department of Chemistry, Shivaji Art's, Comm. & Science College Kannad Dist. Aurangabad 431103, Maharashtra, India

ARTICLE INFO

Article history:
Available online 23 November 2022

Keywords:
Graphene
PCM
Paraffin wax
Thermal conductivity
FTIR
TGA

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 Gr and PW/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_3Gr-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.

Selection and peer-review under responsibility of the scientific committee of the International Conference on Newer Engineering Concepts and Technology.

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

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

* Corresponding author.
E-mail address: dsktcarts@gmail.com (D. Saravanakkumar).

https://doi.org/10.1016/j.matpr.2022.11.137
2214-7853/
Selection and peer-review under responsibility of the scientific committee of the International Conference on Newer Engineering Concepts and Technology.