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Emerging Trends in Thermal Properties of Graphene

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Abstract: We go over the thermal characteristics of graphene, few-layer graphene, and graphene nanoribbons, and we go over some real-world uses for graphene in energy storage and thermal control. The first section of the paper discusses the most recent developments in the graphene thermal area with an emphasis on the experimental and theoretical data on heat conduction in graphene and graphene nanoribbons that have recently been published. In the summary, the effects of the sample's size, shape, quality, strain distribution, isotope composition, and point-defect concentration are discussed. The thermal characteristics of materials used in energy storage that have been increased by graphene are described in the second section of the review. It has been established that the usage of liquid-phase-exfoliated graphene as a filler in phase change materials has promise for the thermal control of high-power density battery parks. The experimental and modelling findings have been disclosed.

Keywords: Graphene, Thermal Properties, Experiments and Modelling.

1. INTRODUCTION

In this study, we cover the thermal characteristics of graphene, few-layer graphene (FLG), and graphene nanoribbons (GNR), and we give an illustration of how graphene is used in materials that undergo thermal

phase changes (PCM). While considering graphene thermal applications, we frequently refer to single layer graphene (SLG), bilayer graphene (BLG), and fullerene (FLG) layers as graphene. The latter is true because there is less of a distinction between SLG and FLG in thermal applications than there is in electronic ones. It can be challenging to tell FLG from

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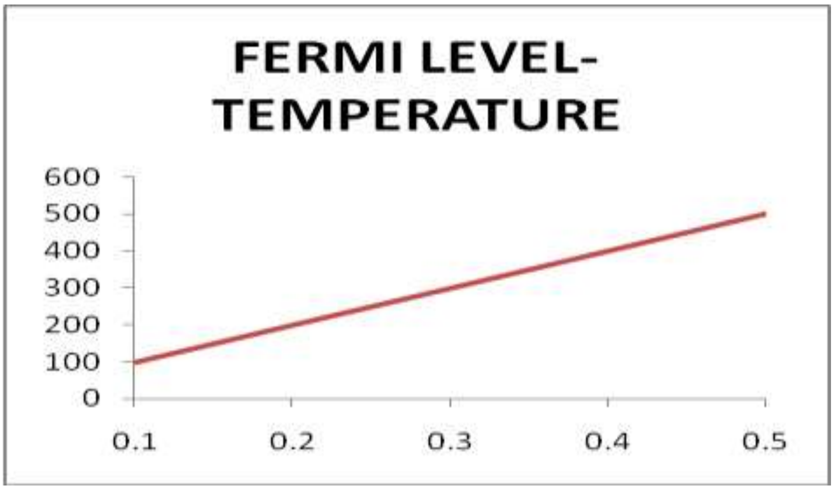
graphite films or FLG from graphite nano-platelets (GnP) utilised in composite materials. The technical definition of SLG is an atomic plane of carbon that is connected to sp2**.**

2. METHODOLOGY

Mobile communications, consumer electronics, and the automotive industry have all advanced thanks to the development of high-power-density batteries, such as Li-ion batteries [14,15,16]. Li-ion battery performance suffers when temperature rises over the normal working range. The battery could explode, experience cell rupture, or experience thermal runaway if it becomes too hot [17,18,19]. High-power density ion battery packs typically include thermal PCMs as part of their thermal management strategy. They lower the temperature rise in the battery by storing latent heat and changing phases across a narrow temperature range [20, 21, 22]. The usual K values for common PCMs at room temperature range from 0.17 to 0.35 W/mK [23]. Si and Cu have thermal conductivities at room temperature (RT) of about 145 and 381, respectively. Standard PCMs

3. RESULTS & DISCUSSION

Sl.NO	Fermi Level ev	Temperature kelvin
1	0.1	100
2	0.2	200
3	0.3	300
4	0.4	400
5	0.5	500



Sl.NO	Fermi Level ev	Temperature kelvin
1	0.6	600
2	0.7	700

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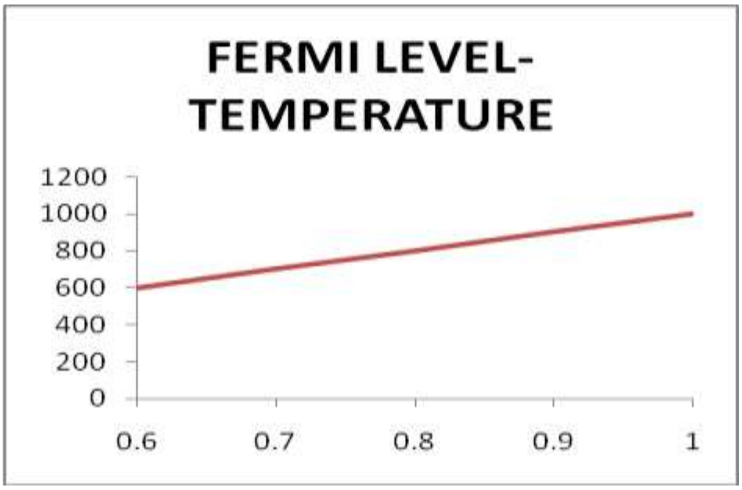
3	**0.8**	**800**
4	**0.9**	**900**
5	**1.0**	**1000**



Sl.NO	**Fermi Level ev**	**Temperature kelvin**
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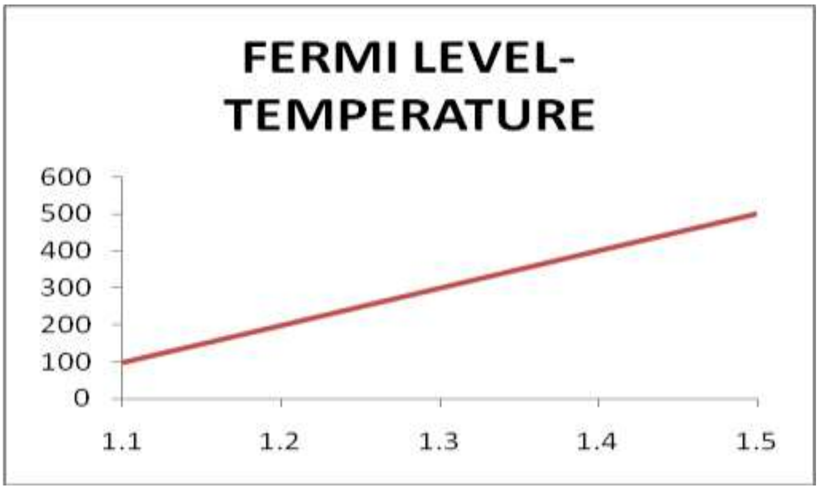
2	**1.2**	**200**
3	**1.3**	**300**
4	**1.4**	**400**
5	**1.5**	**500**



Sl.NO	**Fermi Level ev**	**Temperature kelvin**
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3	**1.8**	**800**
4	**1.9**	**900**
5	**2.0**	**1000**

By measuring the integrated Raman intensity of the G peak [4,5] or using a detector positioned beneath the graphene [32,33], one can measure the amount of heat dissipated in graphene. Since the optical absorption of graphene is wavelength dependent [1,2,34,35,36] and is influenced by strain, defects, and multiple reflections for graphene hung over trenches, it is important to quantify the optical absorption under the precise experimental circumstances. The many-body effects are responsible for the dependence of the graphene light absorption on wavelength [34,35,36]. The thermal conductivity value is obtained by solving the heat diffusion equation for graphene samples with a specific geometry based on a correlation between T and P. To determine P, one needs to look at the graphene's suspended region.

4. CONCLUSION

The use of graphene-enhanced PCMs as energy storage for thermal control in battery packs is demonstrated in this section by way of a concrete example [29]. Increasing PCM's thermal conductivity without lowering its capacity to store latent heat was the aim of this application. The battery packs were made up of cylinder-shaped Li-ion batteries that were joined to a charging-discharging system that provided continuous charging-discharging cycles of 16A and 5A, respectively. Temperature readings were recorded throughout the predetermined 10 charge-discharge cycles utilising installed thermocouples and a data gathering system at predetermined time intervals (DAS). A battery cylinder inside the battery pack had two thermocouples attached to the cathode and anode ends, and a third thermocouple was linked to the battery pack shell, which served as the heat source. A thin sheet of pure carbon that is linked and packed closely together to form a hexagonal honeycomb structure is known as graphene. It is recognised as a "wonder material" since it possesses a variety of astounding qualities, including being the best conductor and the thinnest compound known to man (one atom thick). Because carbon is abundant in nature and is a component of human tissue, it possesses incredible strength and light absorption qualities and is even regarded as environmentally beneficial and sustainable Because of its large relative surface area (which is even larger than that of activated carbon), graphene is frequently offered as an alternative

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