Hybrid Phase-Change Materials With Graphene Fillers For Thermal Management Of Batteries And Battery Packs

Tech ID: 23979 / UC Case 2013-812-0

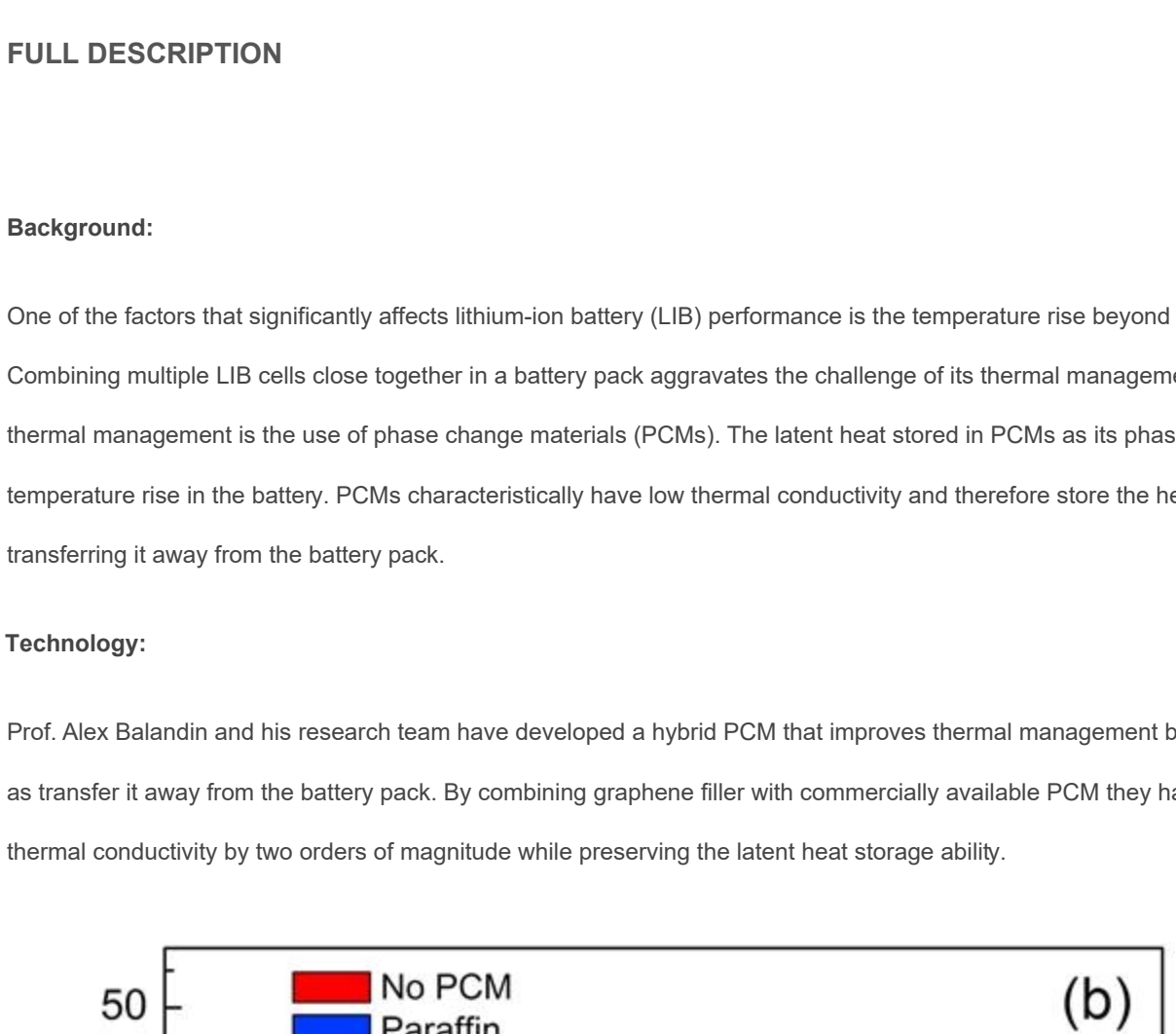
FULL DESCRIPTION

Background:

One of the factors that significantly affects lithium-ion battery (LIB) performance is the temperature rise beyond the normal operating range. Combining multiple LIB cells close together in a battery pack aggravates the challenge of its thermal management. A common approach to thermal management is the use of phase change materials (PCMs). The latent heat stored in PCMs as its phase changes reduces the temperature rise in the battery. PCMs characteristically have low thermal conductivity and therefore store the heat from the battery rather than transferring it away from the battery pack.

Technology:

Prof. Alex Balandin and his research team have developed a hybrid PCM that improves thermal management by both storing the heat as well as transfer it away from the battery pack. By combining graphene filler with commercially available PCM they have been able to increase the thermal conductivity by two orders of magnitude while preserving the latent heat storage ability.



Temperature change inside the Li-ion battery pack during the first ten charging–discharging cycles

CONTACT

Venkata S. Krishnamurty
venkata.krishnamurty@ucr.edu
tel: .

OTHER INFORMATION

KEYWORDS

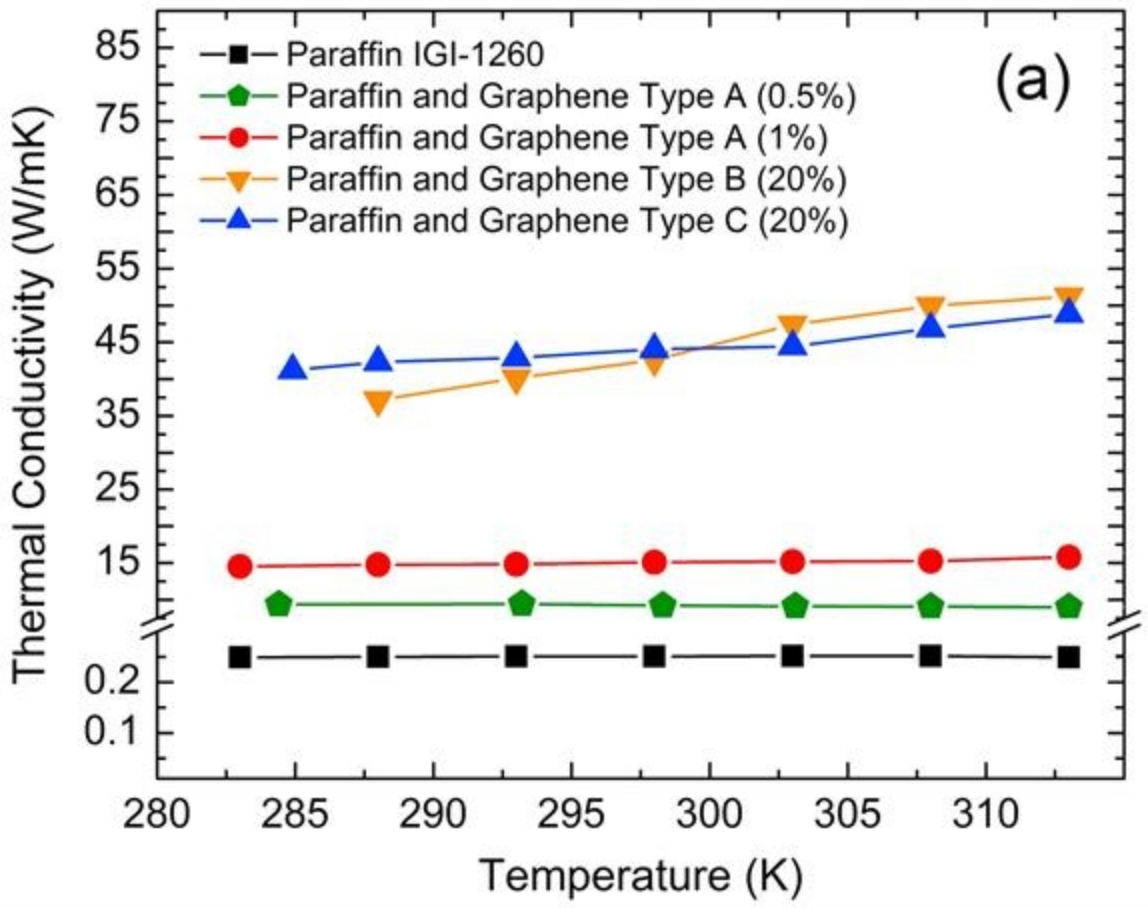
hybrid phase change materials, graphene, fillers, battery, battery packs, thermal management, lithium-ion battery

CATEGORIZED AS

- **Energy**
  - Storage/Battery
- **Transportation**
  - Aerospace
  - Automotive
  - Personal

RELATED CASES

2013-812-0, 2013-156-0



Thermal conductivity of the graphene–paraffin composites with different graphene loading as the function of temperature.

ADVANTAGES

- The thermal conductivity of the hybrid graphene-PCM reaches ~ 15 W/m.K at room temperature compared to 0.25 W/m. K for pristine PCM - with only a 1% loading fraction – a 60-fold increase.
- Good choice of mixing temperature results in good attachment between the hydrocarbon molecules and the graphene flakes – which is responsible for the increase in thermal conductivity.
- The liquid phase exfoliation process used for preparing the graphene is an inexpensive process that can be used for industrial scale production.
- Thermal conductivity of the hybrid PCM exhibits weak temperature dependence thereby making it practical for applications.
- Optimization of a heat sink design with the hybrid PCM would significantly improve the thermal management of battery pack.

STATE OF DEVELOPMENT

Prototype samples and composite PCMs developed and tested in the lab.

SUGGESTED USES

Thermal management of battery packs.

INVENTIONS BY PROF. BALANDIN

Please review all inventions by Prof. Balandin and his team at UCR

RELATED MATERIALS

- Graphene-enhanced hybrid phase change materials for thermal management of Li-ion batteries

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	10,003,111	06/19/2018	2013-812
United States Of America	Issued Patent	9,716,299	07/25/2017	2013-156

RELATED TECHNOLOGIES

▶ Method For Producing High-Efficiency Thermal Materials With Graphene And Metal Fillers

University of California, Riverside

Office of Technology Commercialization

200 University Office Building,

Riverside,CA 92521

otc@ucr.edu

research.ucr.edu/