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Battery thermal management of a novel helical channeled cylindrical Li-ion battery with nanofluid and hybrid nanoparticle-enhanced phase change material
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Abstract
Electric vehicles (EVs) have emerged as a viable alternative to Internal Combustion (IC) engine-powered vehicles, and efforts have been directed toward developing EVs that are more reliable and safer to operate. The safe working of EVs necessitates the use of an efficient battery cooling system. In this paper, cooling of cylindrical type Li-ion battery embedded with helical coolant channels is proposed. The effects of nanoparticles on removing heat from the battery cooling system have been investigated for four different nanoparticle concentrations: 0, 2, 5, and 10% of Al2O3 in the base fluid. Two cases of base fluids are considered: phase change material kept in a concentric container surrounding battery volume and coolant water circulated through liquid channels attached to the outer walls of the PCM (phase change material) cylindrical container. This study presented the three configurations (i) base case PCM-WLC: battery cooling system with a cylindrical enclosure filled with RT-42 phase change material. (ii) base case nePCM-WLC: battery cooling system filled with nano-enhanced phase change material. (iii) nePCM-LC: battery cooling system with helical liquid channels and filled with nano-enhanced PCM. The nanofluid was circulated through the liquid passages connected to the PCM container. Results showed using the helical channels, the nePCM-LC arrangement efficiently removes accumulated heat from the phase change material and provides better battery cooling than straight rectangular channel-based BTMS (battery thermal management system). © 2023

Author Keywords
Battery hybrid cooling; Cylindrical Li-ion battery; Liquid channels; Nanofluids; Phase change material

Index Keywords
Alumina, Aluminum oxide, Automobile cooling systems, Battery management systems, Containers, Coolants, Cooling, Ions, Nanofluidics, Nanoparticles, Phase change materials, Temperature control, Thermal management (electronics), Thermoelectric equipment; Battery cooling, Battery hybrid cooling, Battery thermal managements, Coolant channel, Cylindrical li-ion battery, Cylindrical types, Hybrid cooling, Hybrid nanoparticle, Liquid channels, Nanofluids; Lithium-ion batteries

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