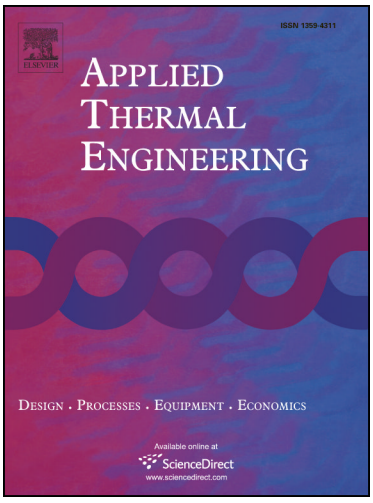

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Optimization of thermal management system for Li-ion batteries using phase change material

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ABSTRACT

This study presents an optimization method of Li-ion battery thermal management system (BTMS) using phase change material (PCM). The optimization objective is to minimize the mass of PCM. Two design constraints should be satisfied during the optimization process: (1) the maximum temperature difference in the BTMS should not exceed the threshold value; (2) the desired working time of maintaining the batteries temperature under operation safe temperature should be fulfilled. A case study of the cylindrical BTMS with PCM is selected to illustrate the proposed optimization method. The expanded graphite (EG)/ paraffin (PA) composite PCM is used in the BTMS. The thermodynamic mathematical models of the system are solved by the commercial software computational fluid dynamics (CFD). The numerical results are validated against experimental data, and a good agreement has been achieved. During the optimization, four types of BTMS which respectively use single, double, three and four batteries, are considered. The effects of battery radius, gap between neighboring batteries, heat generation rate, and top and bottom PCM thickness on the minimum mass of PCM are analyzed. The optimal radiuses of the PCM unit in different conditions are identified. Results indicate that the proposed optimization method is effective