

## ABSTRACT

### FINITE ELEMENT ANALYSIS USING ANSYS OF THE PHASE CHANGE MATERIAL (PCM) COOLING SYSTEMS ON A 3V LIFEPO4 BATTERY CELL FOR BATTERY PACK APPLICATION

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Passive thermal management in LiFePO<sub>4</sub> cells was evaluated using three Phase Change Material (PCM) formulations through transient thermal analysis in ANSYS Workbench at charging rates of 1 C, 2 C, and 3 C. The PCM tested consisted of PCM1 (90 wt% paraffin + 10 wt% expanded graphite), PCM2 (n-docosane), and PCM3 (Suntech P116 paraffin wax). At a speed of 1 C, PCM1 produced the most even temperature distribution with a range of only 26.03–27.45 °C ( $\Delta T \approx 1.42$  °C), PCM2 showed a peak temperature of 27.50 °C, while PCM3 succeeded in suppressing the peak temperature to the lowest value of 27.04 °C. At a speed of 2 C, PCM1 maintained an even temperature distribution in the range of 39.67–54.73 °C ( $\Delta T \approx 15.1$  °C), PCM2 recorded the highest peak temperature of 56.28 °C, and PCM3 reached the lowest peak temperature of 53.54 °C. At a discharge rate of 3 C, PCM1 minimizes the temperature gradient with the same range of 39.67–54.73 °C ( $\Delta T \approx 15.1$  °C), PCM2 acts as a heat buffer with a peak temperature of 56.28 °C, while PCM3 remains the most effective in suppressing the peak temperature to 53.54 °C. Overall, PCM1 excels in maintaining the uniformity of temperature distribution, while PCM3 consistently produces the lowest peak temperatures across all tested charging rates, making it the strongest candidate for fast charging applications in LiFePO<sub>4</sub> cells.

**Keywords :** *LiFePO<sub>4</sub>, Thermal Management, Phase Change Material, Ansys, Finite Element Analysis*