Supplemental information

Early Intervention of Thermal Runaway by Phloroglucinol-Releasing Microcapsules Enables Safe High-Energy-Density Lithium-Ion Batteries

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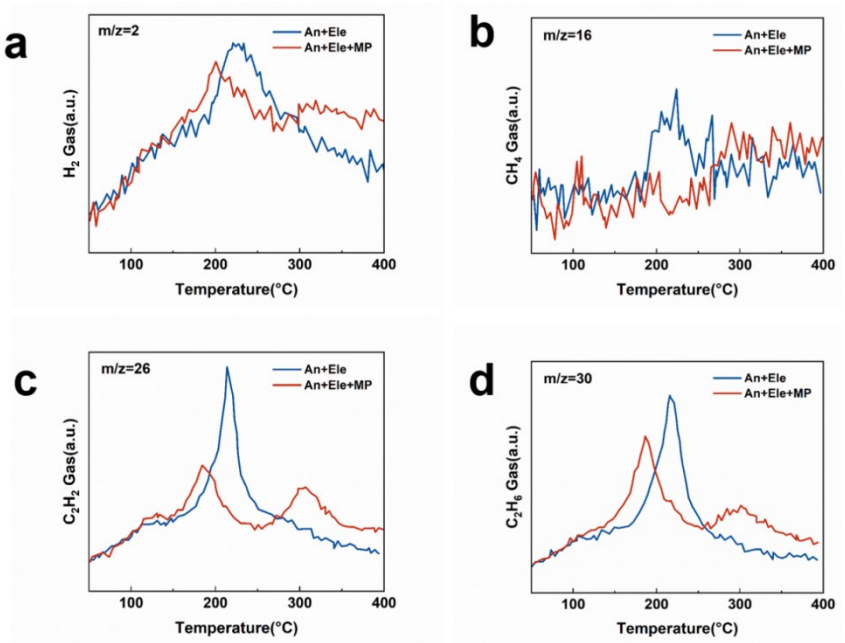

Figure S1. STA-MS of the gas produced after adding MP.(a) H_2, (b) CH_4, (c) C_2H_2, (d) C_2H_6. After the microcapsules were added, the amounts of H_2,CH_4,C_2H_2, and C_2H_6 gases produced during the reaction between the negative electrode and the electrolyte decreased, and the gas production temperature also slightly advanced. This was due to the initial regulation brought about by the MPs.

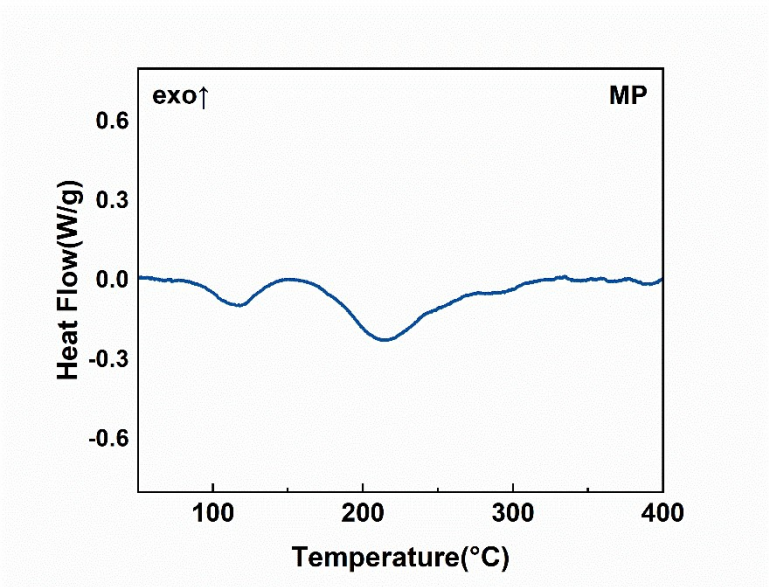

Figure S2. DSC curves of MP. There is an endothermic peak around 120℃, which is caused by the initial cracking of the MUF shell and the absorption of heat. The endothermic peak near 225℃ corresponds to the heat absorption peak of the phloroglucinol itself during its liquefaction.

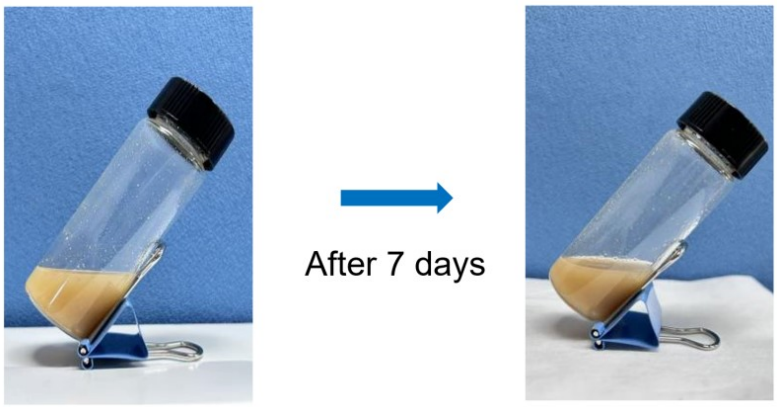

Figure S3. Storage of MP in the electrolyte environment. During the seven-day observation period, the MPs after ultrasonic dispersion did not show any significant changes in their state.

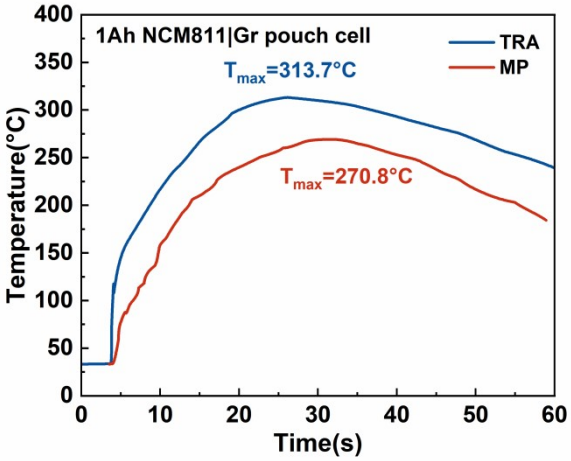

Figure S4. The performance of MP under nail penetration tests. In the nail penetration test, the battery with MP also demonstrated the inhibitory effect of TR. The peak temperature decreased by 42.9℃, and the time to reach the temperature peak was delayed by approximately 5 seconds. MP can also alleviate TR to a certain extent under mechanical abuse conditions.

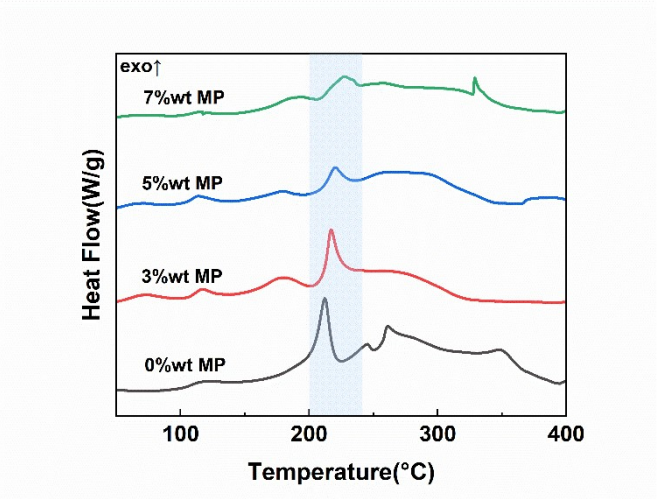

Figure S5. DSC curves of different MP addition amounts. Under different MP addition amounts, the main exothermic reaction peak of TR shows significant changes. When the MP addition amount reaches 5%wt, it achieves a similar effect to 7%wt. Moreover, the smaller the addition amount, the more conducive it is to maintaining the electrochemical performance of the battery. Therefore, 5%wt is selected as the optimal addition amount.

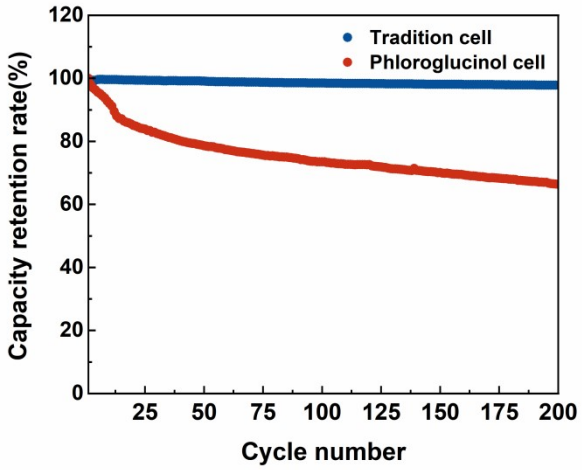

Figure S6. The cycling performance of cells containing phloroglucinol. When phloroglucinol was directly added, the capacity retention rate dropped significantly to 71% after 200 cycles. However, when phloroglucinol was encapsulated in microcapsules, it was able to maintain a capacity retention rate similar to that of traditional batteries after 200 cycles, demonstrating the advantages brought by the microcapsule encapsulation technology.

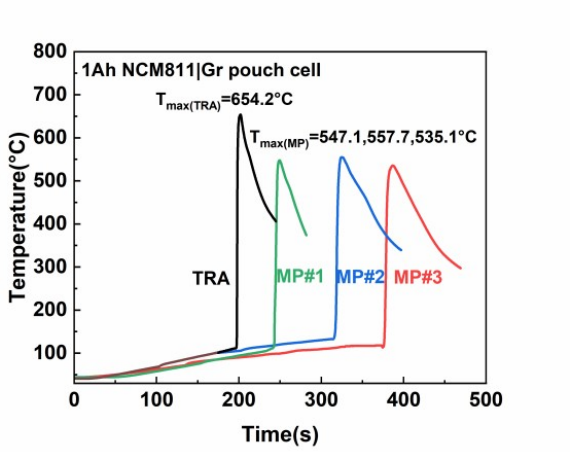

Figure S7. Repetitive lateral heating experiments. In the three repetitive lateral heating experiments, MP#1, MP#2, and MP#3 all demonstrated TR alleviating effects. The peak temperature decreased by an average of 107.6℃, and the triggering temperature increased by an average of 11.3℃. The data indicate that MP has good repeatability in inhibiting TR.

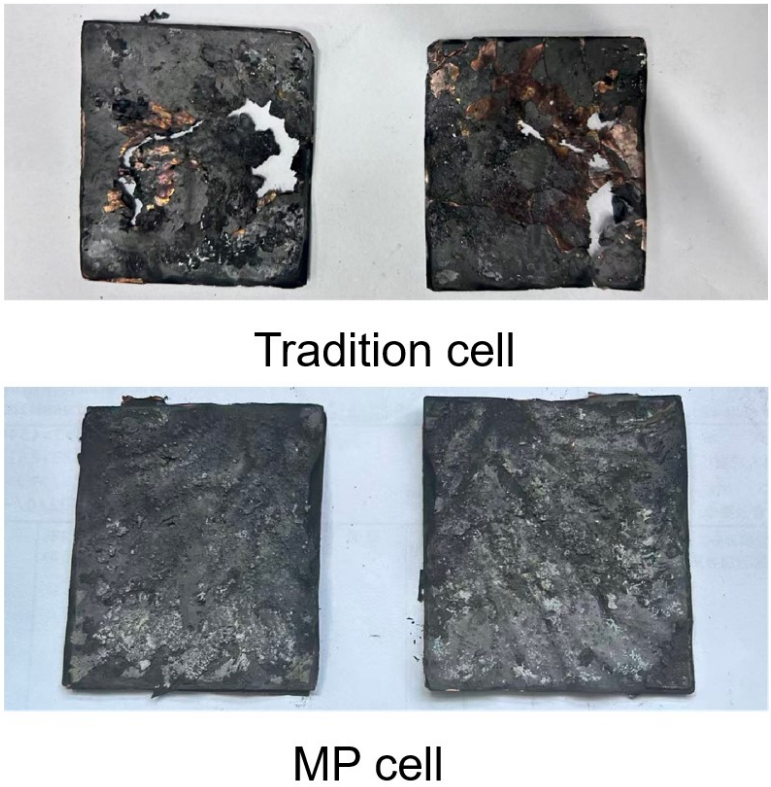

Figure S8. Comparison of wreckage after TR. After TR, the weight loss rate of the traditional cell was 32.1%, while that of the MP cell was 23.9%. Moreover, the electrode sheets of the traditional cell collapsed, while the electrode sheets of the MP cell remained in a more intact state.