

Lithium-ion battery thermal runaway inhalable particle characterization

摘要

锂离子电池（LiB）因其高能量密度和效率，被广泛应用于电子设备、电动车和储能系统。然而在热、电或机械滥用下，电池容易发生热失控（TR）并可能引发火灾或爆炸。在热失控时，电池会排放含有有毒成分的气体和大量的可吸入颗粒，这些排放物对环境与人体健康存在危害。本研究在半开放空间内对一颗 3.4Ah 的圆柱形电池使用加热的方式触发热失控。试验结果表明，一颗圆柱形电池在热失控期间电池温度最高可达 642.3 °C，产生的颗粒数浓度最高可达 1×10^7 #/cm³。结论表明锂离子电池在热失控期间存在显著的安全风险，并为日后改进锂电池设计以及颗粒危害评估提供科学参考。

关键词

锂离子电池；热失控；颗粒表征；颗粒数浓度；热失控温度

Abstract

Lithium-ion batteries (LiBs) are widely used in electronic devices, electric vehicles, and energy storage systems due to their high energy density and efficiency. However, under thermal, electrical, or mechanical abuse, batteries are prone to thermal runaway (TR) and may cause fire or explosion. During TR, the battery will emit gases containing toxic components and a large number of inhalable particles, which are harmful to the environment and human health. In this study, a 3.4Ah cylindrical battery was heated in a semi-open space to trigger TR. The experimental results show that the battery temperature of a cylindrical battery can reach up to 642.3 °C during TR, and the particle number concentration generated can reach up to 1×10^7 #/cm³. The conclusion shows that LiBs have significant safety risks during TR, and provides a scientific reference for future improvements in LiBs design and particle hazard assessment.

Keywords

Lithium-ion battery; Thermal runaway; Particle characterization; Particle number concentration; Thermal runaway temperature

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