Safe and long-lasting batteries based on a fire-extinguishing electrolyte with excellent anode-passivation ability

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State-of-the-art lithium-ion batteries suffers from fires or explosions which impede their large-scale application. To address battery safety problems, various approaches have been reported. They can be divided into two kinds, which are indirect way and direct way. The former generally requires some respondence time to be functioned, while the latter faces the difficulties of compromising the battery performances or manufacturing efficiency. In this work, we show an effective direct approach to building safe batteries, i.e., the fire-extinguishing concentrated electrolyte design (see Figure 1). It can turn the conventional organic electrolytes from "flammable" to "fire-extinguishing", guaranteeing the battery safety without sacrificing battery performance or manufacturing efficiency.

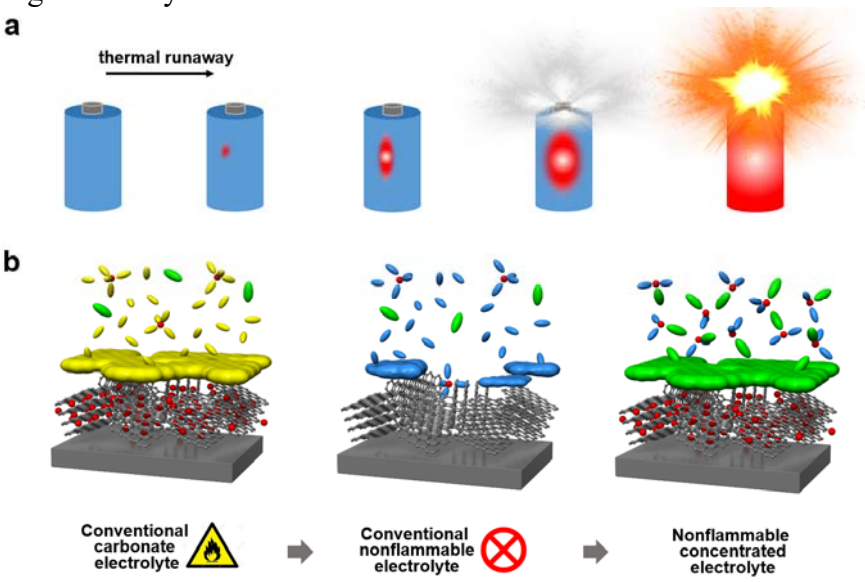

Figure 1 Electrolyte design concept for a safer battery. a, Schematic diagram of a battery explosion caused by the ejection of flammable electrolyte vapor heated following thermal runaway. b, Intercalation behavior of cations (red spheres) into a carbonaceous anode in various electrolytes. A conventional EC-based electrolyte passivates the anode via preferential reduction of the EC solvent (yellow ellipsoids) over anions (green ellipsoids), but its high flammability poses a severe safety risk. An electrolyte with non-flammable solvents (blue ellipsoids) generally cannot passivate the anode to cause continuous solvent decomposition or solvent co-intercalation. A concentrated electrolyte with non-flammable solvents can effectively passivate the anode via the formation of salt-derived SEI (a green film) while functioning as a fire-extinguishing material.

Reference:

[1] J. Wang, Y. Yamada, K. Sodeyama, E. Watanabe, K. Takada, Y. Tateyama, A. Yamada*, *Nature Energy* **3**, 22 (2018).