Li-ion batteries are the critical enabling technology for the portable devices, electric vehicles (EV), and renewable energy. However, the safety and energy density of current Li-ion batteries still need to be improved to satisfy the requirements for these applications. We systematically investigated the electrochemical performance of the nonflammable fluorinated organic electrolytes, water-in-salt electrolytes and solid state electrolytes for high energy Li and Li-ion batteries. The Li dendrite formation in solid state Li metal batteries was proposed and validated. The critical issues of these safe electrolytes are also discussed.

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