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A room-temperature sodium–sulfur battery with high capacity and stable cycling performance

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High-temperature sodium–sulfur batteries operating at 300–350 °C have been commercially applied for large-scale energy storage and conversion. However, the safety concerns greatly inhibit their widespread adoption. Herein, we report a room-temperature sodium–sulfur battery with high electrochemical performances and enhanced safety by employing a "cocktail optimized" electrolyte system, containing propylene carbonate and fluoroethylene carbonate as co-solvents, highly concentrated sodium salt, and indium triiodide as an additive. As verified by first-principle calculation and experimental characterization, the fluoroethylene carbonate solvent and high salt concentration not only dramatically reduce the solubility of sodium polysulfides, but also construct a robust solid-electrolyte interface on the sodium anode upon cycling. Indium triiodide as redox mediator simultaneously increases the kinetic transformation of sodium sulfide on the cathode and forms a passivating indium layer on the anode to prevent it from polysulfide corrosion. The as-developed sodium–sulfur batteries deliver high capacity and long cycling stability.

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