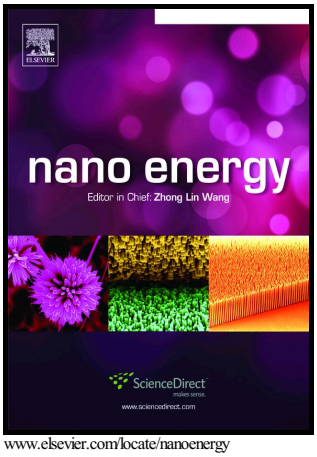

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A high-energy and low-cost polysulfide/iodide redox flow battery

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Abstract

Redox flow batteries (RFBs) have been limited by low energy density and high cost. Here, we employ highly-soluble, inexpensive and reversible polysulfide and iodide species to demonstrate a high-energy and low-cost *all-liquid* polysulfide/iodide redox flow battery (PSIB). In contrast to metal-hybrid or semi-solid approaches that are usually adapted for high-energy RFBs, the all-liquid characteristic of the PSIB is crucial to enable practical scale-up development. Combining the achieved energy density (43.1 Wh $L^{-1}_{Catholyte+Anolyte}$) and the inherent low materials cost of sulfur and iodine compared to vanadium, the PSIB system demonstrates a significantly lower materials cost per kilowatt hour ($ 85.4 kWh^{-1}) compared to the state-of-the-art vanadium-based redox flow batteries ($ 152.0 – 154.6 kWh^{-1}). *Operando* UV-Visible spectroscopy reveals superior electrochemical reversibility of both electrolytes. With its demonstrated energy density, inherent low material cost and benign chemical natures, the *all-liquid* PSIB offers a promising solution for high-energy-density and low-cost energy storage applications.

Graphic Abstract.