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Energy-Dense and High-Power Li-Cl_2/I_2 Batteries by Reversible Chemical Bonds

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Abstract : Conversion-type lithium-ion batteries show great potential as high-energy-density, low-cost and sustainable alternatives to current transition-metal-based intercalation cells. Li-Cl_2/Li^-I_2 conversion batteries, based on anionic redox reactions of Cl^-/Cl^0 or I^-/I^0, are highly attractive due to their superior voltage and capacity. However, a redox-active and reversible chlorine cathode has not been developed in organic electrolytes. And thermodynamic instability and shuttling issues of iodine cathodes have plagued the active iodine loading, capacity retention and cyclability. By reversible chemical bonds, we develop reversible chlorine redox reactions in organic electrolytes with interhalogen bonds between I and Cl for Li-I_2 batteries and develop a highly thermally stable I/I_3--bonded organic salts with iodine content up to 80% as cathode materials for the rechargeable Li-I_2 batteries. The demonstration of reversible chemical bonds enabled rechargeable Li-halogen batteries opens a new avenue to develop halogen compound cathodes.

Keywords : conversion-type, chlorine, halogen cathode, high energy density, iodine, interhalogen bond, lithium-ion batteries
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