Rechargeable Li-liquid batteries using waste Li-ion battery materials as cathodes

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By introducing lithium super-ionic conductor (LISICON) solid electrolytes to current Li ion battery technology, the array of choices for cathode materials dramatically widens to include solid, liquid, and even gas phases. Based on this concept, new cathodes consisting of liquid or gas phases have been studied to develop advanced battery systems, such as the Li-aqueous liquid and aqueous Li-air batteries.

In this study, for the first time ever, we report on the development of a rechargeable Li-liquid battery that uses an aqueous mixture of waste Li ion battery materials for its liquid cathode (Figure 1). Employing a multi-layer electrolyte, which included a solid electrolyte, allowed us to use an aqueous mixture as a liquid cathode. Lithium extracted from the waste material proved to be effective in the battery discharge/charge processes. In particular, when using Li₄Ti₅O₁₂ as the anode, an excellent cycle-life performance with high coulombic efficiency was observed in this battery system. Such results show promise for developing a higher performing rechargeable energy storage system that is both cost-effective and environmentally friendly.

Figure 1. Schematic diagram of a Li-liquid battery system that uses waste battery materials as a liquid cathode.