Trash to Treasure: Converting Aluminum Cans into a Valuable Additive for Li-S Batteries with an Unprecedented Performance

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Americans throw away 1 in 3 aluminum (Al) cans every year, worth ~$1 billion, although recycling scrap Al requires only 5% of the energy used to make new Al. The motivation behind this work is to address the following questions: is there a way to convert Al cans into a valuable product? If so, what would it be? Over the past few years, lithium sulfur (Li-S) batteries have attracted attention as an enabling technology because of their high energy density. The commercialization of Li-S batteries is limited by the poor electronic conductivity of S, the polysulfide shuttle, and a relatively low volumetric energy density. The aim of this research is to address these challenges by developing an additive for Li-S batteries. Al powder prepared from soda-cans was mixed with sulfur to form a composite with the S-loading up to 90 wt%. The electrochemical performance shows that the Al-S composite in Li-S cells exhibits a high capacity retention (>90% after 200 cycles), in addition to the remarkable ability to stabilize quickly (<10 cycles). Moreover, the rate performance of Al-S is improved over conventional carbon additives. Post analysis suggests that Al-S surface interaction is a possible origin for this improvement and it is feasible to develop Li-S cells with a high volumetric energy density by using an Al-S electrode. This approach offers a means to the aluminum industry for new applications. The use of powders made from Al cans in high performance batteries provides an eco-friendly solution to increase the sustainable use of energy. More importantly, the technology developed in this research may improve energy storage systems in next generation space and unmanned vehicles and passenger cars requiring faster charging and higher volumetric energy density.

Awards Won:

Arconic Foundation: Material Science or Engineering, First Award of $2,500

China Association for Science and Technology (CAST): Award of $1,200