Moving Beyond Current Energy Density Boundaries

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Lighter weight and longer life batteries for electrochemical energy storage are needed for many applications including aerospace, transportation, portable electronics, and biomedical devices. Inclusion of inert materials as part of the battery electrode significantly decreases energy density as they contribute to the weight and volume of the electrode, but not to its energy content.

This work presents approaches toward the minimization of inert materials in battery cathodes. Bimetallic materials that undergo reduction displacement reactions to generate metallic particles in-situ are examined where an in-situ conductive matrix is formed. Specifically, the formation of silver nanoparticles, are detailed to rationalize a 15,000 fold increase in conductivity with initial discharge. Additionally, the viability of using self-standing metal oxide / carbon nanotube substrate (CNT-S) electrodes in rechargeable cells is presented. The CNT-S serves the multiple roles of the binder, the Al foil and the conductive carbon additive providing a possible path toward lighter weight batteries.