

Beyond Li-ion – A case for magnesium battery systems

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Abstract

Multivalent battery systems like rechargeable magnesium (Mg) batteries are garnering more interest as candidate post-lithium (Li) battery systems, for eventual applications in electric vehicles (EVs) and plug-in hybrid vehicles (PHVs). This is primarily due to concerns over the long range performance of current Li battery systems, and the space requirements for future EVs and PHVs. Mg, being divalent and denser, is theoretically capable of delivering a higher volumetric energy-density (3833 mAh cm^{-3}) than Li (2061 mAh cm^{-3}), making it a viable alternative battery system for addressing such concerns. In order to be competitive with current Li-ion systems, high voltage and high capacity Mg systems must be developed. To date, various organohaloaluminates have been utilized as alternative electrolytes for Mg systems, due to the incompatibility of high voltage conventional battery electrolytes (TFSI, ClO_4^- , PF_6^-) with Mg metal anodes. However, reports have shown that these organohaloaluminate electrolytes provide a limited operating voltage window when tested against typical battery current collectors. It has recently been reported that it is possible to use conventional battery electrolytes by changing the type of anode, from a Mg metal anode to a Mg-ion insertion-type anode (e.g. high energy-density Bi and Sn), enabling Mg-ion transport through the anode/electrolyte interface. Here, we report recent advancements in the use of such insertion-type anodes for rechargeable Mg-ion batteries, using conventional battery electrolytes, as well as advancements on cathode materials for Mg battery systems. Further, various issues at the electrode/electrolyte interfaces will be discussed via an overview of current Mg battery systems.

Biography

Nikhilendra Singh is currently a Senior Scientist at the Toyota Research Institute of North America (TRINA), where he works in the Materials Research Department. His current interests lie in the development of new materials and methodologies for battery systems beyond Li-ion, with emphasis on magnesium battery systems, as well as studying the effect of interfaces on battery performance. He completed his Ph. D. in Chemistry from Purdue University in 2010 and has been with TRINA since, and holds several reputable journal publications and patent authorships.