Melting, coating, and all-solid-state lithium batteries

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The joint research team of Prof. Yoon Seok Jung (UNIST, School of Energy and Chemical Engineering) and Prof. Seng M. Oh (Seoul National University) discovered a new way to develop all-solid-state lithium batteries without a risk of conflagration or explosion. It is the method of melting the solid electrolyte and coating that melted electrolyte around the electrodes. This research outcome was introduced on *Advanced Materials* on December 22, 2015.

The organic liquid electrolyte, mainly used in existing lithium-ion batteries, has a characteristic of easily getting gasified or burned. Therefore, all-solid-sate lithium batteries are now getting an attention as the alternative option since they are non-flammable.

However, the powder type of solid electrolyte does not permeate, compared to the liquid electrolyte. If the contact between electrolytes and electrode active materials is not active, it would be more difficult to move lithium-ion to the electrode. Furthermore, it will not be simple to elevate the performance revelation of batteries.

To solve these problems, Prof. Jung's research team developed a way to coat the active materials with the solid electrolyte. This process called the solution-process works by diffusing the powder type of active material in the liquid from melted solid electrolyte and vaporizing the solvent. After the solution-process, it became more possible to coat the layers of solid electrolyte on the active materials.

The research team also developed a material for the solid electrolyte by adding the iodized lithium (LiI) to the methanol liquid which is the compound (Li4SnS4) based on tin (Sn). The compound's ionic conductivity was originally low, but it got increased by getting mixed with LiI. Consequently, by combining two materials together, it became possible to develop the solid electrolyte with high ion conductivity and air stability.

Prof. Jung says, "A newly developed solid electrolyte has the high ion conductivity and no toxicity problem. In addition, the prices of a raw material and a solvent (methanol) are comparatively low. With this technology, commercialization of solid lithium battery will be available sooner than we thought."

More information: Kern Ho Park et al. Solution-Processable Glass LiI-Li SnS Superionic Conductors for All-Solid-State Li-Ion Batteries , *Advanced Materials* (2015). DOI: 10.1002/adma.201505008

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