

Improvement of Anode Material for Better Performing Li-ion Batteries

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Li ion batteries are widely used in mobile consumer electronic devices, due to the high energy density, high electromotive force and long cyclability. There is interest in the use of LIB for high power and wide temperature range applications such as electric vehicles, satellites, military applications as well as grid storage. Therefore, different methods have been utilized to further improve the battery in terms of capacity and safety. Graphite is the commercially used anode material due to its low flat working voltage vs. lithium, low cost and long cyclability. Although LIB technology is currently at an advanced stage, there are few drawbacks that need resolving.

Current Li ion batteries have the inability to work at a wide temperature range. At low temperatures batteries tend to freeze, and at elevated temperatures the electrolyte decomposes or can even lead to explosion. This study shows a method that can be utilized to increase the working temperature range by introducing co-solvents and additives. Electrochemical and surface analytical methods have been used to understand the formation of the solid electrolyte interface and how it works to improve the performance.

Another problem in LIBs is the low capacity of graphite that limits its usage in high power applications. Silicon is one of the most promising candidates for the next generation's Li ion batteries with a gravimetric capacity that is 10 times that of graphite. But the use of this material is limited due to its volume variation of ~300% in the cycling process which leads to destruction of the electrode. This study also shows the use of novel small molecular binders to improve the cycling performance of the silicon electrodes. The surface characterization of the study gave insights that lead to the development of an artificial SEI on silicon particles that could further improve the performance of this anode material.