Nano Designs for Lithium Battery Anodes

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The increasing use of electronics requires highly effective, flexible, sustainable, and safe energy supply systems. Lithium-based batteries are the most- used energy storage devices due to the larger amounts of energy stored in. However, the energy and power density balances of existing battery systems are still not satisfactory. Electronic conductivity and ionic transport are crucial in enhancing the battery performance. Several approaches have been investigated to modify or replace the electrode materials to enhanced aforementioned properties. Nanomaterials offer great features to overcome widely known problems by enabling the occupation of all intercalation sites available the particle volume. Although these features lead to tolerate high currents and promising solution for high-energy and power density, the nature of the electrode materials allow limited supply for greatly developed electronics.

Supported by modern battery engineering, the conventional Li-ion battery chemistries are close to their theoretical limits. At the same time, new approaches on the battery systems have also been developing to exceed these limits.

Positive electrodes, also known as cathode, are usually the main contractor in increasing capacity in a battery. Besides, the negative electrode sides, called as anode, are mostly vital in contributing energy density and stability. Synergistic effect of the electrochemical reactions between anode and cathode cannot be ignored either.

Recently, cathode architectures have been evolving from metal oxide-based electrodes to sulfur-based electrodes to obtain higher capacity and lower cost. Whereas the anode architectures seem to have not found its course exactly yet. Although, the story of the negative electrode has started with lithium metal at the beginning, however, it has continued on graphite for a long time due to many important safety concerns. Despite all the challenges, indispensable charm of lithium metal has been continuing to keep it on the agenda. At the same time, the attraction of anodes such as silicon, which provides high capacity but have many challenges, extends the alternatives.

Here in this talk, it will be discussed the nano designs from conventional anodes to next generation anodes for lithium-based batteries.

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