TECHNOLOGY

Atomic Layer Deposition for Metal Anode Passivation

OVERVIEW

Background:

Lithium metal is of great interest to the battery community: as the lightest and most electropositive alkali metal, Li has a low density, resulting in an extremely high specific capacity value of 3.86Ah/g and energy density of 11,701Wh/kg, making it the holy grail of battery anodes. Other light metals – Na, Mg, and Al – have high energy density as well. But all of these are plagued by their very high chemical and/or electrochemical reactivity, which leads to degradation of energy storage capacity with time and charge/discharge cycling. Besides causing degradation, the high reactivity of these metal anode materials makes it extremely difficult to produce effective, controlled passivation layers that protect the anode surface.

Despite advances in commercializing Li ion batteries, a wealth of resources document the need for substantially higher energy and power from electrical energy storage technologies, for transportation (electric vehicles), grid storage (power leveling), and other applications. Major R&D centers increasingly look to metal anode systems - Li anodes coupled with advanced oxide, sulfur, or oxygen cathodes in advanced batteries. Materials and processes to produce protective layers directly on Li, Na, Mg, and Al anodes are thus a critical requirement for future batteries.

Innovation:

Researchers at the University of Maryland have developed an innovative Method to Passivate Metal Anodes using atomic layer deposition (ALD), which produces uniform, reproducible, very thin layers with thicknesses controlled to the level of atoms. The University of Maryland method prescribes an integrated ALD process for achieving highly effective thin protection layers directly and reproducibly on Li or other metal anodes. This invention provides two major benefits. First, it provides an improved metal anode tailored for retaining high capacity in long-term cycling with specific metal anode battery chemistry. Second, once the passivation has been incorporated into the anode, specifications may be relaxed for the ambient control required in the dry room environment where the battery is to be assembled.

APPLICATIONS

· High energy density battery

ADVANTAGES

· Scalable to high throughput roll-to-roll and batch manufacturing
· Prevention of capacity degradation with charge/discharge cycling
· Effective on rough or smooth areas of metal anode systems
· Enables new generation of metal-anode-based batteries

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CATEGORIES

- Engineering
- Power Electronics
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EXTERNAL RESOURCES

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