LICENSING OPPORTUNITY: PRELITHIATED LITHIUM ION BATTERY AND MAKING A PRELITHIATED LITHIUM ION BATTERY

DESCRIPTION

Problem

The existing methods are chemical or electrochemical in nature and require the use of reactive Li-containing reagents (sacrificial additives, donors, or mixing with stabilized lithium metal powder (SLMP) or organic solvents and lithium salts in liquid electrolytes wetting metallic lithium foils to introduce the Li ions into the material under an electrochemical potential. Under these conditions, unwanted side reactions inevitably occur between the components and thereby create an SEI layer on the electrode. The SEI layer is unwanted and robs battery capacity by increasing the impedance of the system. It is an additional barrier that the Li+ ions must pass through to reach the active electrode material.

Invention

The proposed method allows the injection of Li+ ions directly into the material and does not need the wet chemical or electrochemical prelithiation with liquid electrolytes and metallic lithium foils, sacrificial additives, donors, or mechanical mixing with SLMP, inducing consumption of lithium for the formation of passivation films or an artificial SEI. Through the dry, in-vacuo prelithiation procedure described here, one can avoid these unwanted side reactions and reduce the interfacial impedance in the cell. In addition, electrode materials prelithiated by the injection of Li+ ions show enhanced stability in dry and ambient air conditions and under ageing. Furthermore, the current initial lithiation steps are typically done on fully assembled cells where there is a fixed amount of lithium. A fraction of this Li is then consumed both in (a) converting the electrode material to its lithiated state and (b) creating the SEI layer. Over time, the SEI is known to grow, leading to capacity fading upon cycling of the cell.

BENEFITS

Potential Commercial Applications

Li-ion batteries and high energy density systems beyond Li-ion (Li-S, Li-02 (air) batteries) show high potential for numerous emerging applications EVs with more than 300 miles range, unmanned aerial vehicles (high altitude pseudosatellites) (UAVs/ HAPSs), unmanned ground vehicles (UGVs), and grid-scale energy storage systems. Therefore, this technology has the potential for commercialization and will likely lead to the creation of new high-tech jobs in the U.S.

Global demand for Li batteries will grow from 27 GWh in 2011 to 124 GWh by 2020.

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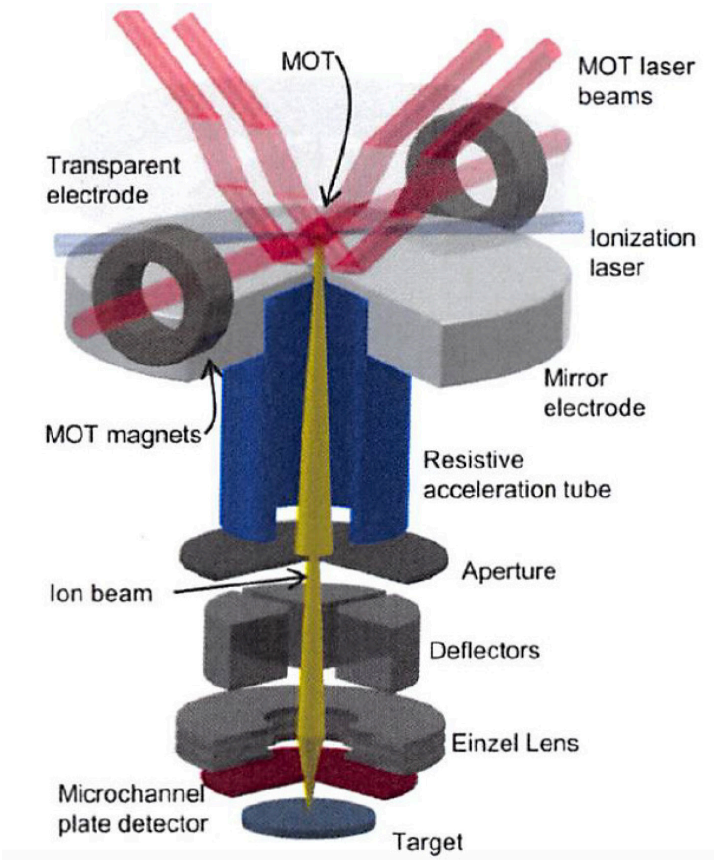
Competitive Advantage

There would be several advantages over current practices for introducing Li ions into the electrode materials.

The dry, in-vacuo lithiation process enables not only the significant reduction of the undesired consumption of Li but also the modification of the structure of the electrode materials by defect engineering during the interactions of injected Li+ ions with materials, which will lead to smaller cells and higher energy densities.



Lithium magneto-optical trap-based ion source (Li MOTIS).

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