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Non-Confidential Description - PSU No. 3921
"Single-Ion Conductors for Lithium-Ion Batteries"

Keywords/Field of the Invention:

Lithium Battery, Electrolyte, Polymer Membrane, Rechargeable Energy Storage Devices

Links:

Inventor website

Inventors:

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Background

Current commercially available lithium batteries almost universally utilize liquid and polymer electrolytes that are binary salt conductors. Conductivity results predominately from the anions rather than the lithium salts. Due to the lack of electrode reaction, anion buildup at the electrode/electrolyte interface ultimately results in power loss and battery failure. Single-ion conductors have long been recognized as offering the potential advantages of a spatially uniform anion distribution that enables the passage of larger currents through the cell, lower joule heat per unit of current that lessens the chance of thermal runaway, and the absence of electrochemical interactions of anions with electrodes for improved stability. No single ion conductor described in the prior art possessed sufficient conductivity (i.e. > 10-4 S/cm at room temperature) to be commercially competitive.

Invention Description

The subject invention covers a novel class of single-ion electrolyte demonstrating a nearly uniform tLi+, state-of-the-art conductivities (e.g. > 10-3 S cm-1 at room temperature) over a wide range of temperatures (-20 oC to 60 oC), high electrochemical stability (up to 4.7 V), and outstanding mechanical properties. Membranes composed of these materials function both as ion conducting medium and separator in the batteries. A polymer film saturated with carbonate solvents recorded a tLi+ value of above 0.98. Cells covered by the subject invention demonstrated excellent cyclability with almost identical charge and discharge capacities. Even after forty (40) cycles, the coulombic efficiency remained about 100%, with no appreciable drop in the open-circuit voltage over 1000 hours. The cell delivers a discharge capacity of 153 mA h g-1, which is equivalent to the reported capacity value of existing membranes. The film also retains sufficiently high conductivities at low temperatures, e.g. 7.4x10-4 S cm-1 at -20 oC.

Status of the Invention

The rechargeable batteries containing membranes of the invention have been reduced to practice. Samples are available for evaluation.

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