Optimized Lithium Anode/Carbon Monofluoride Batteries Operable at High Temperatures

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The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing lithium anode/carbon monofluoride cathode (Li/CFx) batteries that are capable of operating at temperatures greater than 100 °C.

Overview

Developing batteries with improved performance and safety requires considering a variety of factors. Optimal batteries should provide high voltage, storage of substantial amounts of energy, reliable and safe operation, low-cost and low-weight manufacturability, and long life without significant maintenance. Li/CFx batteries, which have a lithium metal anode and a carbon monofluoride cathode, are a promising type of battery due to a higher energy density than all other lithium primary cells. However, Li/CFx batteries suffer from voltage delay at the beginning of discharge and high polarization, limiting them to use in low rate, small volume applications. Recent advances in electrolytes have expanded the useful range of Li/CFx batteries; however, they are operable only at temperatures at or below 85 ºC. Li/CFx batteries capable of operating at elevated temperatures are needed for the cells to be useful in a wider range of environments.

The Invention

UW-Madison researchers have developed a Li/CFx battery that operates at temperatures in excess of 100 ºC. In this battery, alkyl carbonates are replaced with organosilicon-based electrolytes. The organosilicon electrolytes and CFx cathode are contained within a stainless steel coin cell, which also contains the lithium anode, a polypropylene separator and a salt. The electrolytes have low vapor pressure and low flammability, enhancing the safety and maximizing the operating temperature of the battery. In addition to operating at elevated temperatures, the battery possesses the optimal performance characteristics expected from CFx-type batteries.

Applications

- Military devices such as radio communication devices, GPS units and thermal imaging devices that are designed for the battlefield and exposure to heat generated by explosions
- Battery-powered devices such as cameras and sensors used near the bottom of oil drilling areas that are exposed to geothermal heat

Key Benefits

- High performance at temperatures at or above 100 ºC
- Improved energy density and constant discharge voltages when compared to other battery types
- Enhanced safety due to electrolytes with low vapor pressure and low flammability
- Practical production cost
- Long-term reliability
- Significant energy storage deliverable in a responsive manner

Additional Information

For More Information About the Inventors

- Robert Hamers

Related Technologies

- For information about an improved electrochemical capacitor that uses organosilicon electrolytes, see WARF reference number P08415US.

Tech Fields

- Clean Technology : Energy storage, delivery & resource efficiencies

For current licensing status, please contact Jennifer Gottwald at jennifer@warf.org or 608-960-9854