



## ELECTROCHEMICAL ENERGY STORAGE

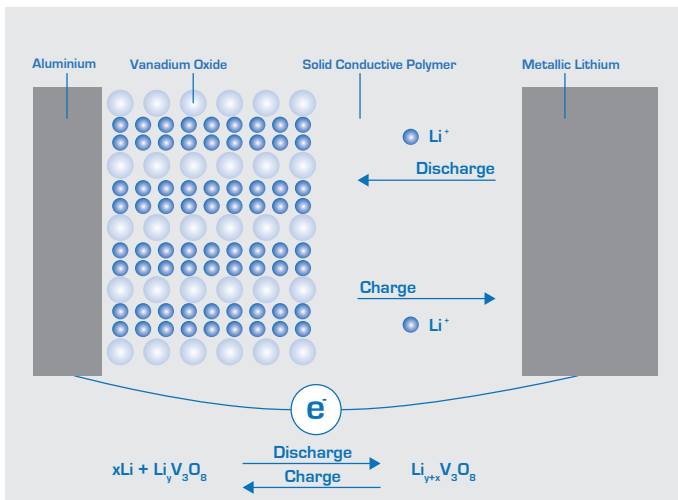
### 1. Technical description

#### A. Physical principles

A Lithium-Metal-Polymer (LMP) Battery System is an energy storage system based on electrochemical charge/discharge reactions that occur between a positive electrode (cathode) based on a metal oxide intercalation compound and a negative electrode (anode) that is typically made of lithium metal.

The cell reaction is an intercalation of lithium ions into the structure of the cathode during the discharge cycle, and a de-intercalation of lithium ions from the charged cathode and its plating onto the anode during the charge cycle. The cell operation needs to run at an internal temperature of 70-80 °C.

Illustration: Charging principle of LMP



#### B. Important components

The main components are the following:

- Electrodes physically separated by a dry solid polymer
- Cells composed of assembling of elements
- Modules composed of assembling of cells and elements
- Battery systems composed of a large assembling of cells or modules, a thermal management system and a control system
- Power Conversion System (PCS)

#### C. Key performance data

Power range	Up to some Mw
Energy range	Up to some MWh
Energy (power) density	100 Wh/kg

(\* ) NOT including auxiliary loads

#### D. Design variants (non exhaustive)

Different design variants can be found according to the application:



LMP battery for the Blue Car (Bolloré)



## 2. State of the art

This technology is currently used by the Bolloré "Blue Car" which is the electric vehicle (EV) of the car-sharing service operated in Paris (also called "Autolib") and in some cities such as Lyon-Villeurbanne and Bordeaux in France, and Indianapolis in the USA.

## 3. Future developments

While the main developments are focused on the performance improvements related to the transport industry, this technology is expected to be used also in the energy storage field, ranging from a few kWh to several MWh of stored energy. It is intended for a variety of end-users including: electricity consumers (individuals, businesses, etc.) and the players in the electrical networks.

## 4. Relevance in Europe

The LMP technology is well-suited for EVs and is developed by only one European actor: Batscap.



## 5. Applications

The LMP technology is currently mainly used in the transport sector (EV) but could also be used for the following applications:



Uninterruptible Power Supplies (UPS): telecom, data centres, hospitals,...



Customer and Grid storage

## 6. Sources of information

- EASE Members
- Batscap
- Bolloré
- Industrial Applications of Batteries [M. Broussely & G. Pistoia]
- Lithium-Metal-Polymer Batteries: From the Electrochemical Cell to the Integrated Energy Storage System [Avestor]