Lithium-Sulphur Battery

European Association for Storage of Energy

Electrochemical Energy Storage

1. Technical description

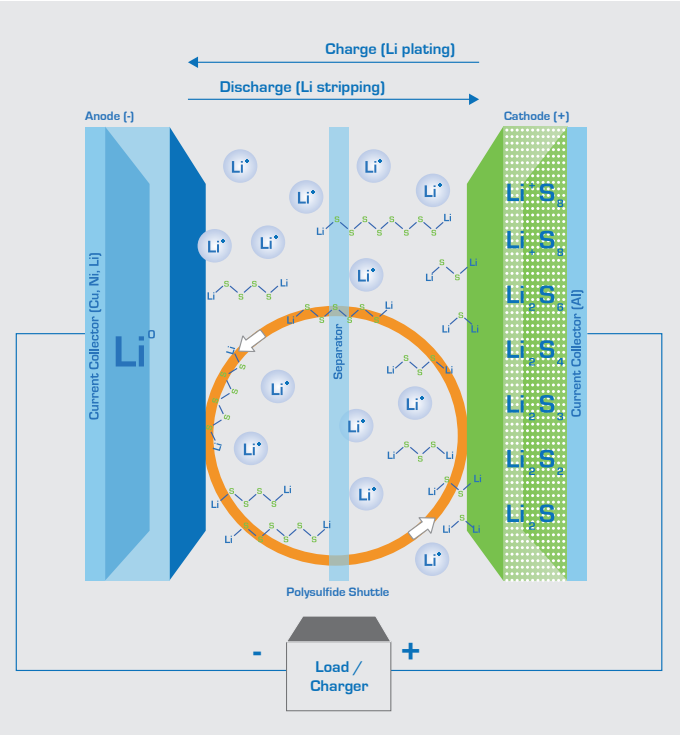
A. Physical principles

A Lithium-Sulphur (Li-S) battery system is an energy storage system based on electrochemical charge/discharge reactions that occur between a sulphur-based electrode (cathode) and a negative electrode (anode) that is typically made of lithium metal.

Lithium ions are stripped from the anode during discharge and form Li-polysulphides in the cathode. Li_2S in the cathode is the result of a complete discharge. On recharge, the lithium ions are plated back onto the anode as the Li_2S_x moves toward S_8

High-order Li-polysulphides (Li_2S_3 to Li_2S_8) are soluble in the electrolyte and migrate to the anode

Illustration: Charging principle of Li-S



B. Important components

The main components are the following:

- Elementary cell composed of an assembling of electrodes, electrolyte and separator
- Modules composed of assembling of cells
- Battery systems composed of a large assembling of cells or modules and of a control system
- Power Conversion System (PCS)

C. Design variants (non exhausitive)

Different design variants can be found since on the one hand, the Li-S technology is not yet stabilised and since, on the other, different applications are targeted.

2. State of the art

This technology was developed by spin-off companies since 2002-2004 for some electronic devices:

3. Future developments

The main developments are related to the scaling-up to large capacity cells and to the development of battery systems for transportation (e-bike, scooters, EV & PHEV) and for energy storage.
Some R&D efforts have been launched to solve the following issues:

- short-circuits due to metallic lithium dendrites during charging
- low cycle life
- self discharge through polysulphides dissolution
- ageing (corrosion, heterogeneous behaviour, etc)
- safety (volatile, low boiling temperature electrolytes)
- suitable structures for electrodes

4. Relevance in Europe

This technology is considered as one of the candidates to succeed the Li-Ion battery in the upcoming (5 to 10) years because of the following advantages:

- Larger energy density: 350 Wk/kg up to 500 Wh/kg in the future
- Use of low-cost materials that is expected to produce an overall cheaper technology compared to Li-Ion.

5. Applications

This technology is considered a potential candidate for the automotive applications (EV/PHEV) but is expected to also find a place in the grid storage and consumer storage applications if the main issues are solved.

6. Sources of information

- EASE Members
- SION
- OXIS
- Industrial Applications of Batteries (M. Broussely & G. Pistoia)