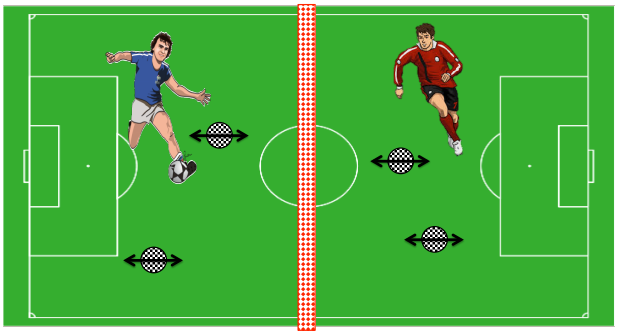
NRP 70 Energy Turnaround National Research Programme NRP 70 — Transport and mobility

New rechargeable metal-water and metal-air batteries

Overview

Prof. Katharina M. Fromm, UniFR



LITHIUM

WATER / AIR

metal ion (ex. Li^+)

Electrolytes

Net and Membrane

Objective

To develop dual electrolytes and membranes for a new generation of Li-water and/or Li-O_2 batteries

Requirements

- Long run (no degradation)
- High mobility (high ionic diffusion)
- No violent reactions

Only "football" is allowed to pass = only Li^+ and water (aqueous electrolyte) permeable in porous structure

1. Development of  : aqueous and non-aqueous electrolytes

Hervé YAO, UniFR

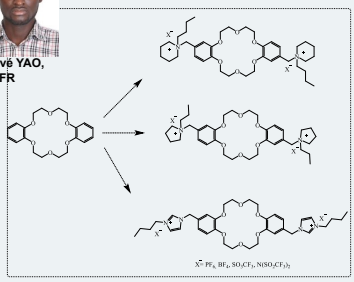


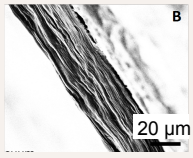
Fig. 1. Non-aqueous electrolyte: new ionic liquids with crown ethers

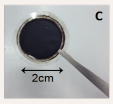
- Avoid corrosion of membrane
- Avoid the saturation of discharged products

Dr. Nam Hee KWON, UniFR

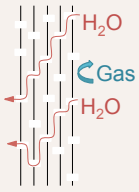
Fig. 2. Aqueous electrolyte: using a buffer solution

2. Development of  and  for a Li-Water Battery





Selective Transport



Prof. Hyung Gyu PARK, ETHZ

Mengmeng DENG, ETHZ

Fig. 3. Design of a 2D-platelet stack membrane of graphene oxide: structure (top) and electrode (bottom)

Outlook (near term)

- GO stability under an aqueous Li environment
- Mass transport phenomena of Li^+ across cathode
- Exploration of other cathode architecture for controlled mixing of Li^+ and H_2O

Energy Turnaround

Current challenges of the energy turnaround

- Alternative, highly efficient energy storage systems
- Reduce CO_2 emission
- Green energy devices

Our contribution

A new generation of energy storage system: Li-water or Li-O_2 batteries

- 10 – 20 times higher energy density than conventional batteries
- Greener energy storage system: water and O_2 instead of transition metal oxides
- Stand-alone energy storage system, e.g. in Swiss mountains or for wind/solar energy production as local storage device
- Requires feasibility studies and highly reversible reactions

Contact

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