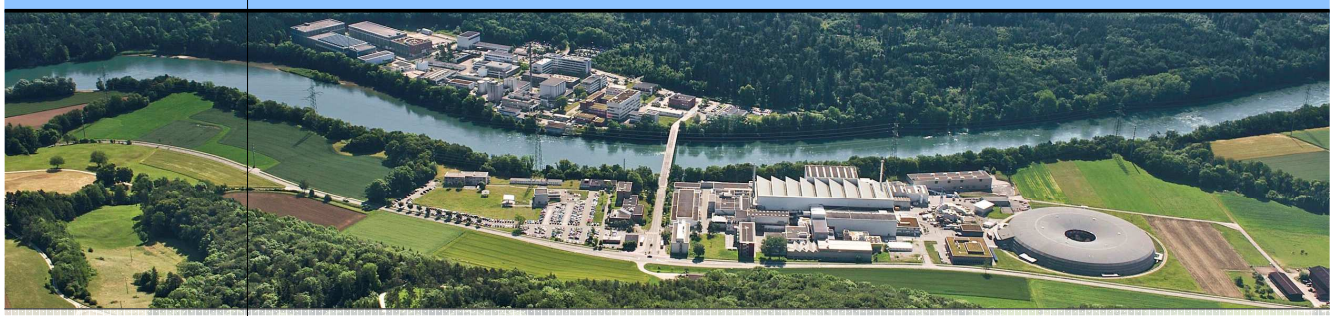


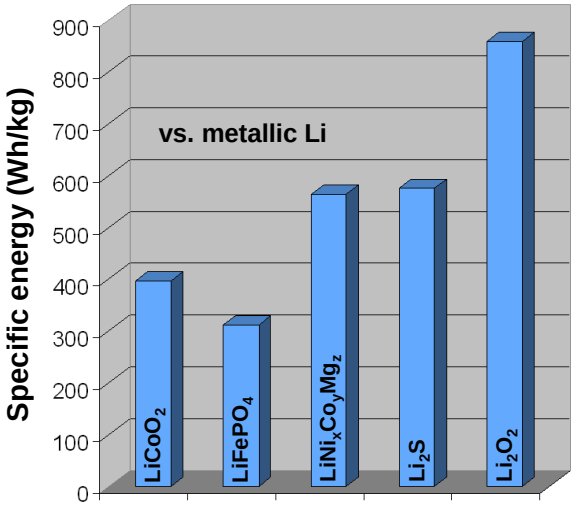
Wir schaffen Wissen – heute für morgen

Paul Scherrer Institut
Erik J. Berg / Electrochemistry Laboratory / ENE

Dosing Differential Electrochemical Mass Spectrometry (D-DEMS) for Li-O_2 Batteries

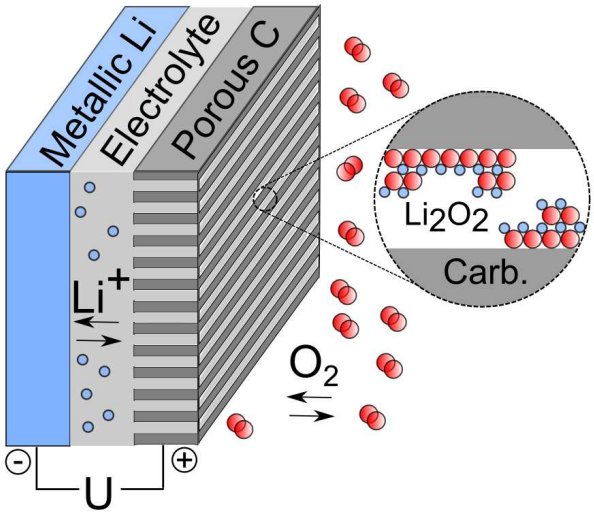
Li-O_2 battery

Practical energy comparison



Pouch cell estimates

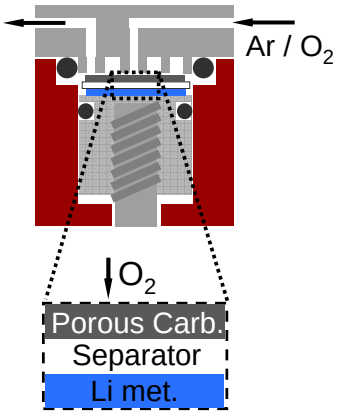
Li-O_2 cell operational principle



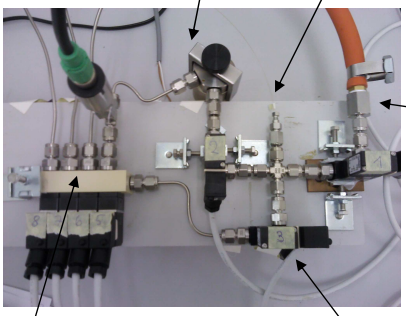
$2Li + O_2 \leftrightarrow Li_2O_2$ $\quad U^o = 2.96V$

Li-O_2 cell and DEMS development

Cell

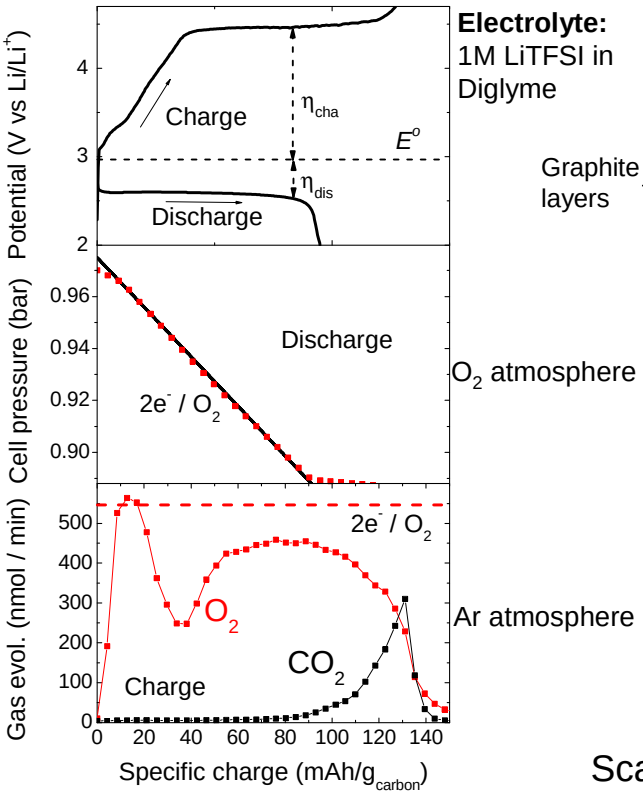


DEMS



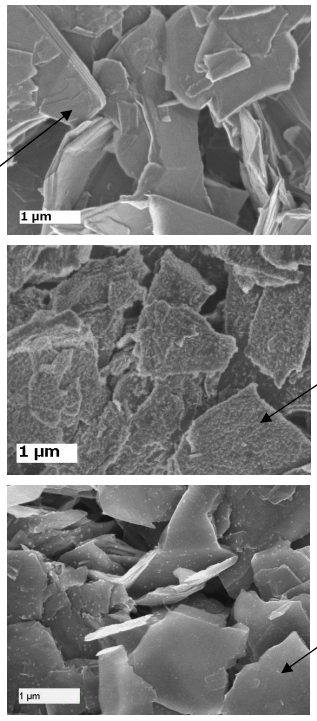
Dosing approach

Li-O_2 cell cycling



Electrolyte:
1M LiTFSI in Diglyme

Porous C electrode:
80% SFG6
20% Li-Nafion



Scanning electron microscopy

Conclusions

- **Li-O_2 cell and Dosing Differential Electrochemical Mass Spectrometer developed**
  - Oxygen consumption (ORR) recorded by cell pressure measurement during discharge and oxygen evolution (OER) monitored during charge by partial pressure measurement in a dosing approach.
  - ORR corresponds to formation of Li_2O_2 during the whole discharge ($2e^- / O_2$).
  - OER initially reaches an evolution rate of $2e^- / O_2$ but then decreases, indicating parasitic side reactions.
  - Evolution of CO_2 from side reactions is observed above 4.3 V vs. Li^+/Li during charging.
  - Results are in line with experimental data reported in literature. However, **the new dosing DEMS enables the measurement of both total and partial pressure changes simultaneously with the possibility to run several cells in parallel**.

- Future perspectives
  - DEMS is a key tool for studying the Li-O_2 battery cell reversibility (e.g. ORR/OER ratio) but complementary experimental techniques such as SEM, XPS, and FTIR are required.
  - Focus is on fundamental understanding of the origin of high overpotentials and irreversible chemistry.
  - LiO_2 and Li_2O_2 reactivity with electrolyte and carbon matrix are the critical aspects.