MgH_2 as anode in Li-ion batteries

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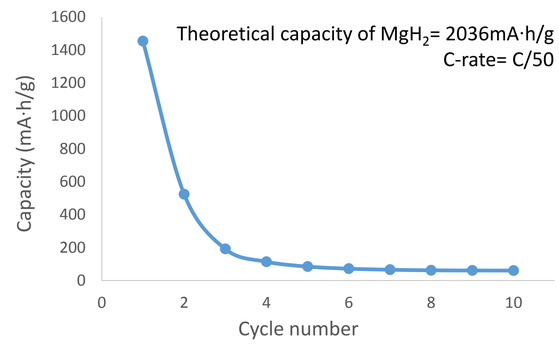
In order to develop further the application of Li-ion batteries for electric vehicles and electrical grid system, metal hydride-based materials have been suggested as promising anode materials.

Why MgH_2?

- High theoretical capacity (5 times higher than graphite)
- Low polarization
- Relatively low cost

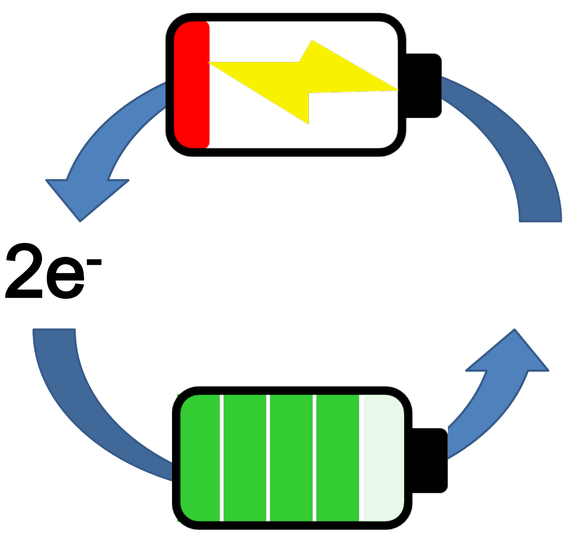
BUT

- Unsatisfactory cyclic stability



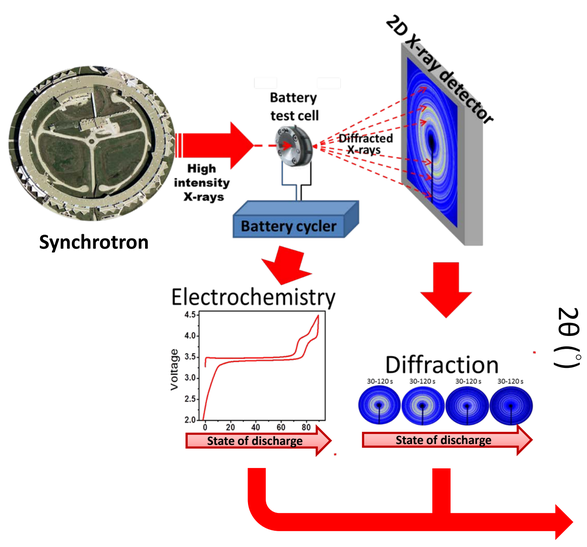
LiMg alloy formation?
Particle aggregation?

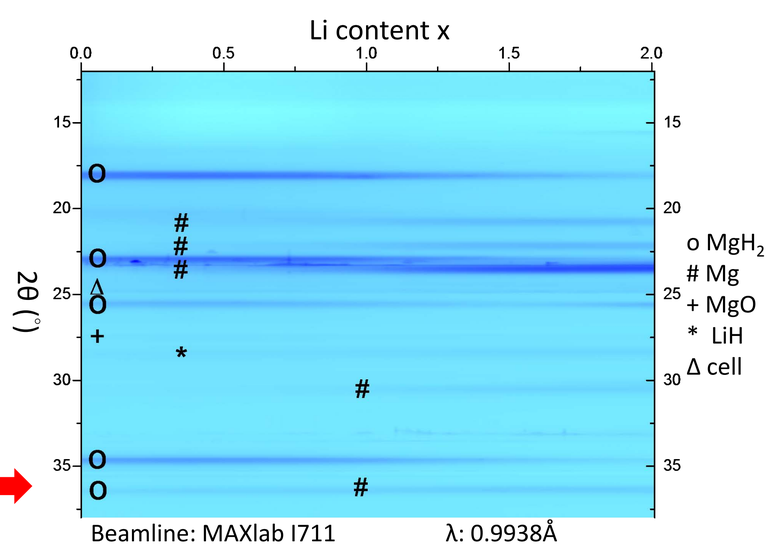
Electronic path being blocked by insulating LiH?



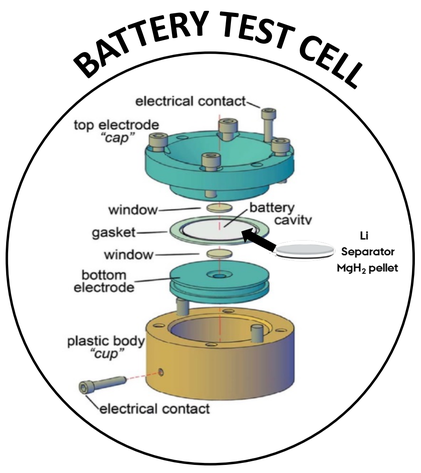
$MgH_2 + 2Li^+ + 2e^-$ *Charged* → $Mg + 2LiH$ *Discharged*

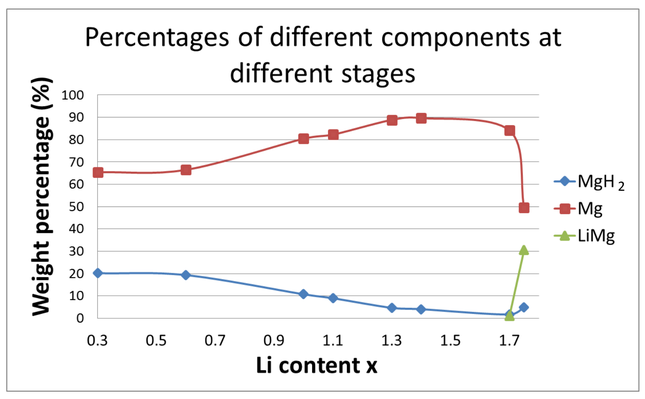
Battery testing by *in-situ* X-ray diffraction

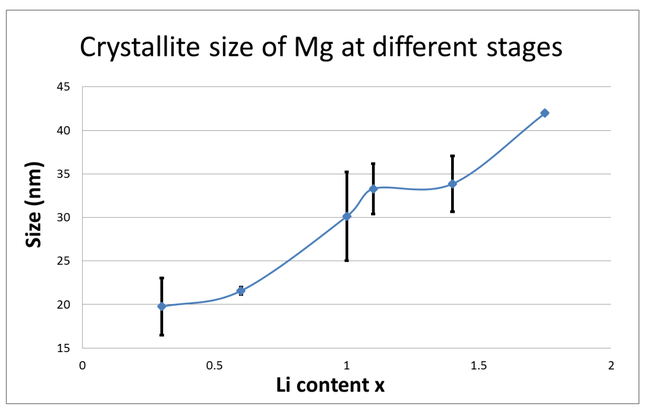




Beamline: MAXlab I711 λ: 0.9938Å
C-rate: C/10



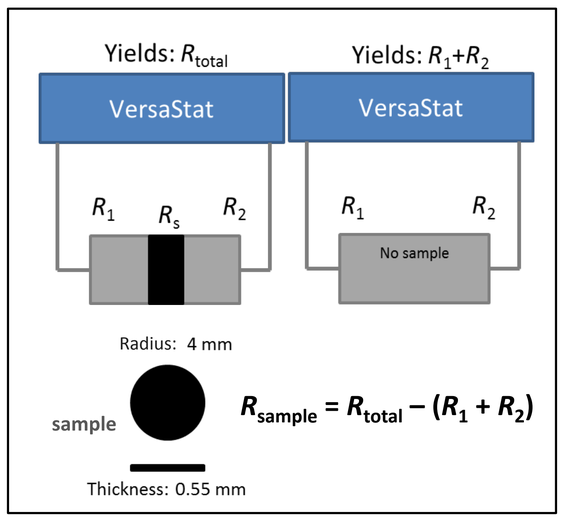


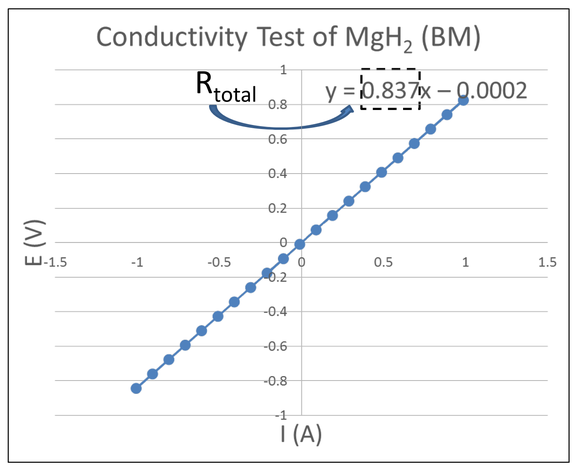


Formation of LiMg alloy when x> 1.7!!!

The size of Mg increased with higher Li content

Differential conductance measurement





	Sample 1	Sample 2	Sample 3
Name	BM	Cycled	x=1.8
Electrochemical test	NA	C/50	C/50
		E_{limit}: 0.005V and 3V	E_{limit}: 0.005V and 3V x_{limit}: 1.8
		11 Discharge and charging cycles	1 Discharge cycle
R_{total} (Ω) – slope of I-E plot	0.837	16.13	13.71
R_{sample} (Ω)	0.698	15.99	13.57
Resistivity ρ (Ω·m)	0.0638	1.46	1.24
Conductivity σ (S/m)	1.57E+01	6.85E-01	8.07E-01

σ (BM) > σ (x=1.8) > σ (Cycled)
BUT
Differences are within 2 orders of magnitude

Conclusions

1. Formation of LiMg alloy reduces the available amount of Mg for the charging reaction.
2. Mg has larger crystallite size with increasing Li content, and leads to a smaller interface area for the conversion reaction.
3. Change in conductivity shows that LiH has a small influence on the electronic transfer for the conversion reaction.

Acknowledgement

Assistance of Prof. Orimo's group from Tohoku University for the differential conductance measurement is gratefully acknowledged. The research leading to these results has received funding from the People Program (Marie Curie Actions) of the European Union's Seventh Framework Program FP7/2007-2013/ under REA grant agreement n° 607040 (Marie Curie ITN ECOSTORE www.ecostore-itn.eu).