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ELECTROREDUCTION OF Li_2O TO GENERATE Li FOR CHEMICAL REDUCTION OF UO_2

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OBJECTIVES

To study the kinetics of Li_2O electroreduction in molten salts

- Li_2O concentration
- Temperature
- Molten salt composition
- Current density
- Electrode materials

To study the kinetics of chemical reduction of UO_2 with electrogenerated Li

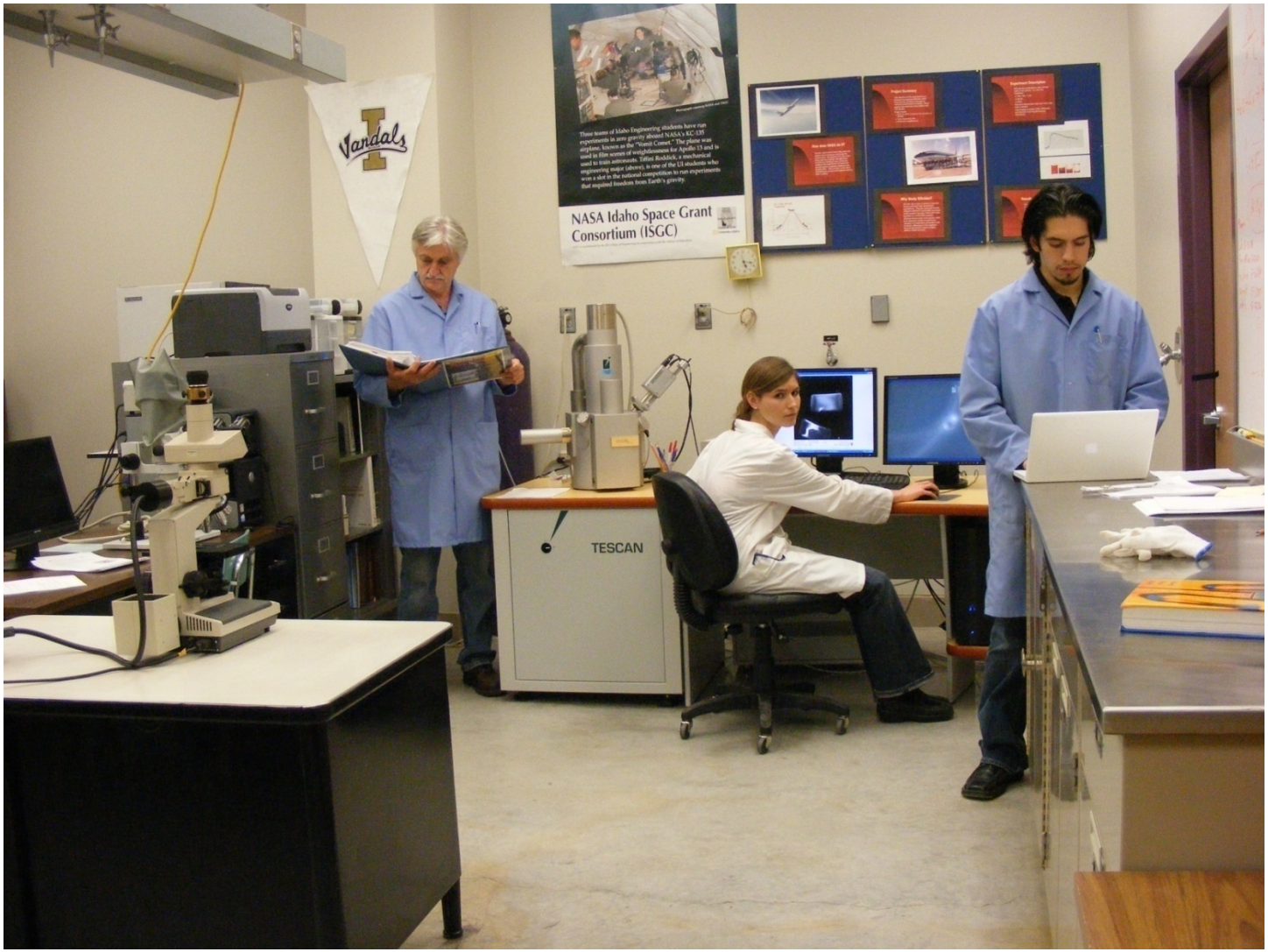
- Li concentration
- Temperature
- Molten salt composition
- UO_2 geometry
- Electrodes/cell arrangement

NUCLEAR ENGINEERING LABORATORY

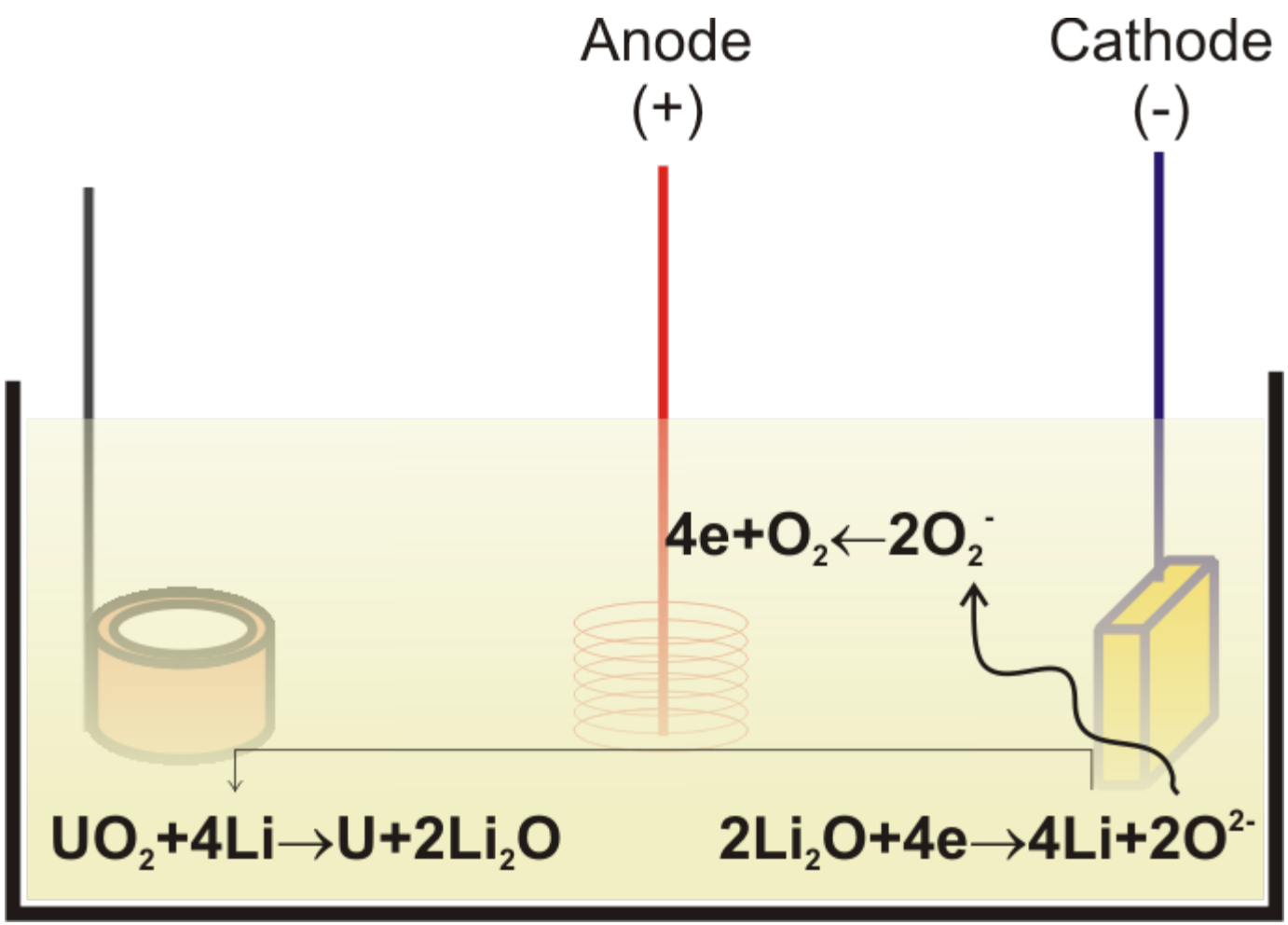
- Glove boxes
- SEM and optical microscopes
- Electrochemical instrumentation
- Molten salt experimental setups (furnaces, rotating disk, echem)

Experimentation in the glove box and characterization with SEM

NUCLEAR ENGINEERING LAB: SEM is now enabled for remote control. Students will run the SEM from Idaho Falls



SCHEMATICS OF THE CONCEPTUAL APPROACH

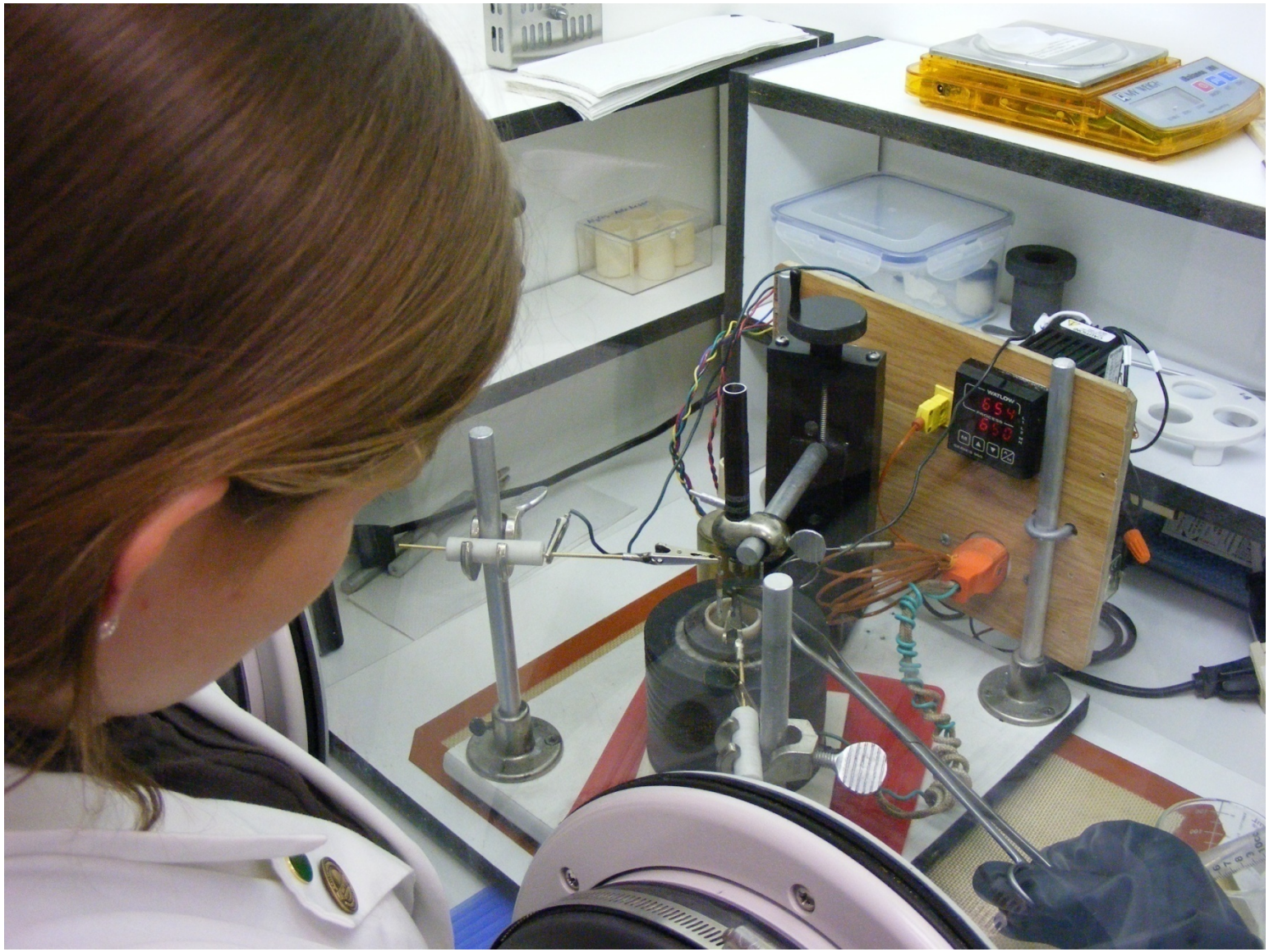


Standard ΔG(kcal/M) and Reduction Potential of Pure Substances at 650 °C

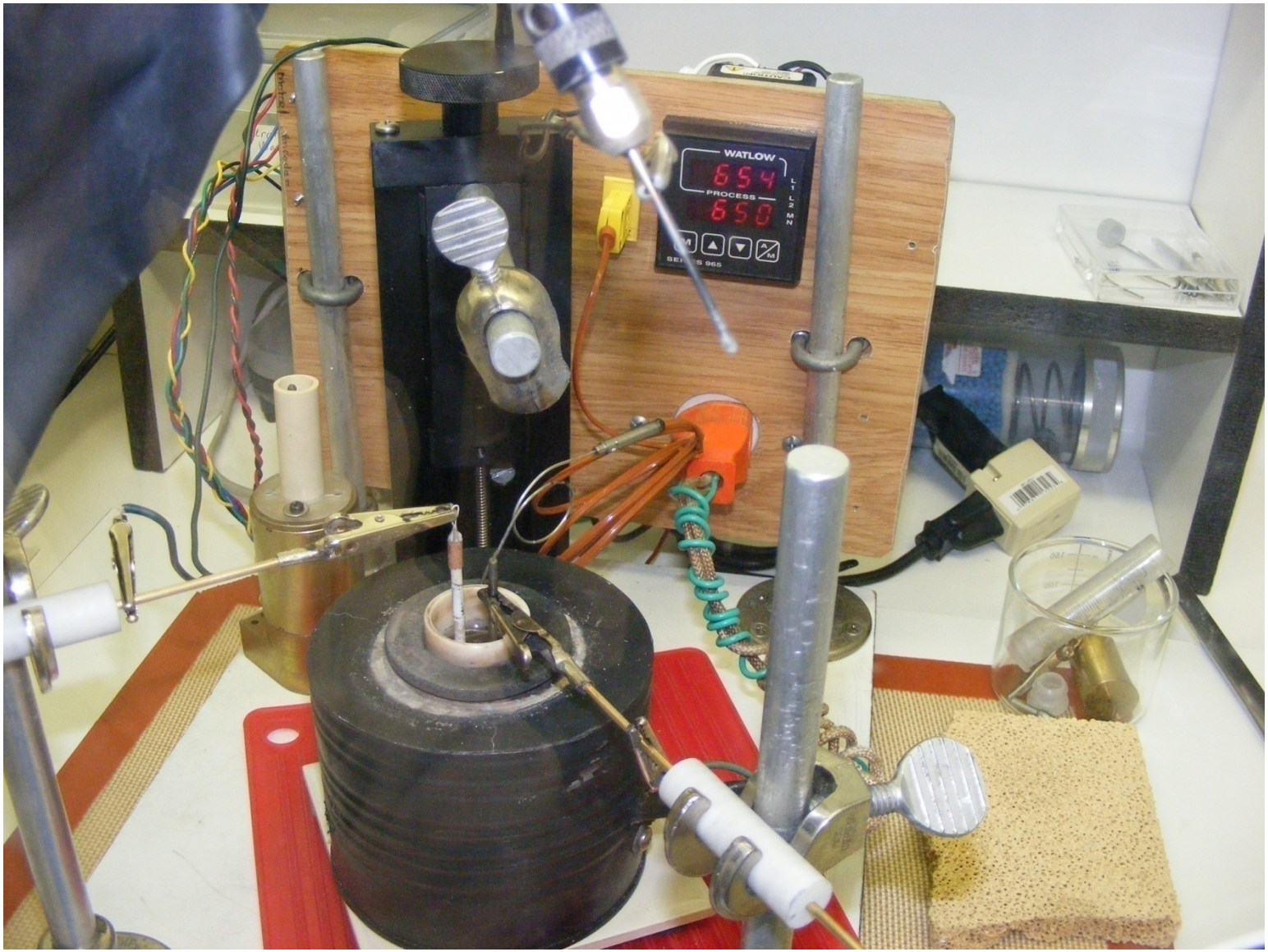
	ΔG(kcal/M)	Reduction Voltage
$Li_2O(s) \rightarrow 2Li(s) + 1/2O_2(g)$	114.0	-2.47
$LiCl(s) \rightarrow Li(s) + 1/2CL_2(g)$	79.8	-3.46
$UO_{2(}s) \rightarrow U(s) + O_2(g)$	221.1	-2.40
$U_3O_8(s) \rightarrow 3UO_2(s) + O_2(g)$	44.4	-0.48

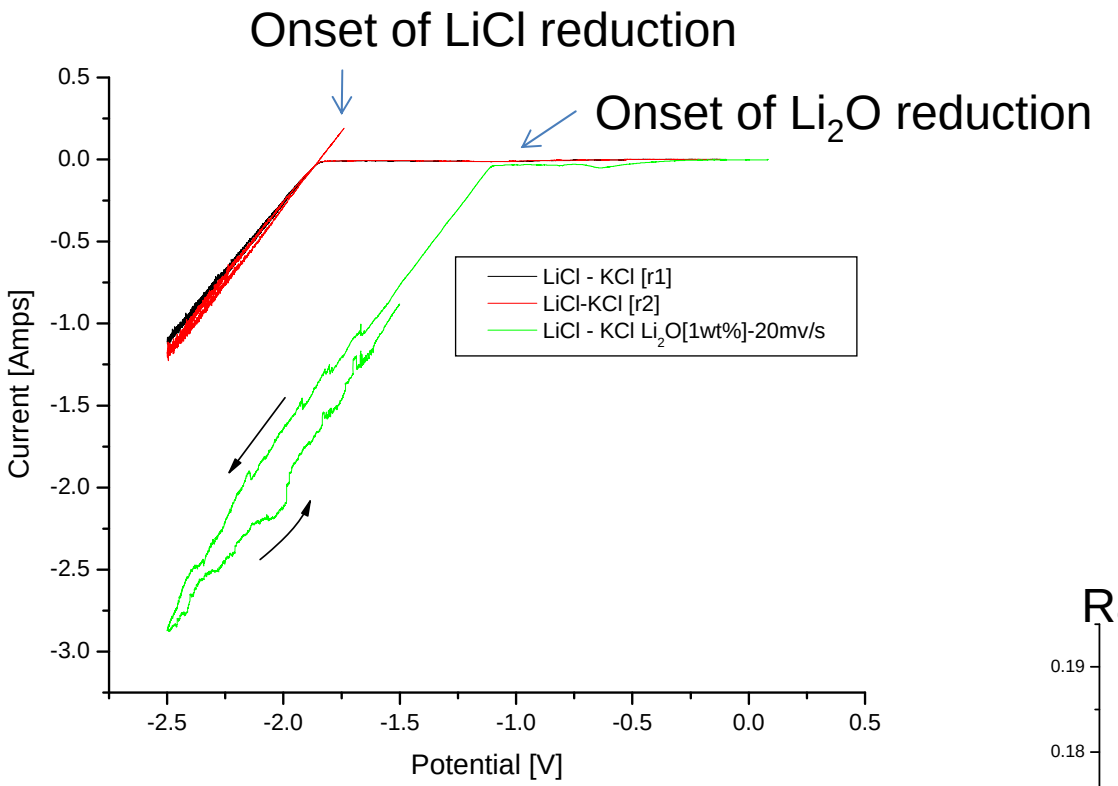
SOME RESULTS

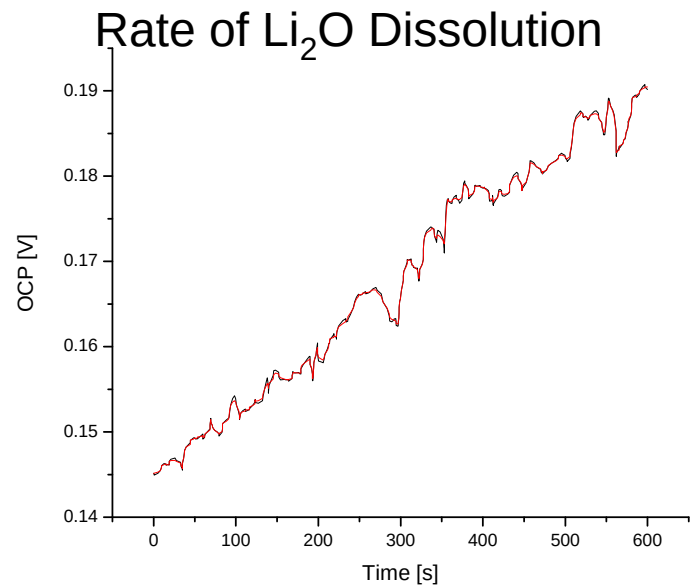
PREPARATION TO RUN AN EXPERIMENT
(Li-KCl molten salt electrolyte at 650 ^{o}C)



ELECTRODEPOSITED LITHIUM PULLED OUT OF MOLTEN SALT




Onset of LiCl reduction
Onset of Li_2O reduction
LiCl - KCl [r1]
LiCl-KCl [r2]
LiCl - KCl Li_2O[1wt%]-20mv/s
Current [Amps]
Potential [V]
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
-2.5
-2.0
-1.5
-1.0
-0.5
0.0
0.5

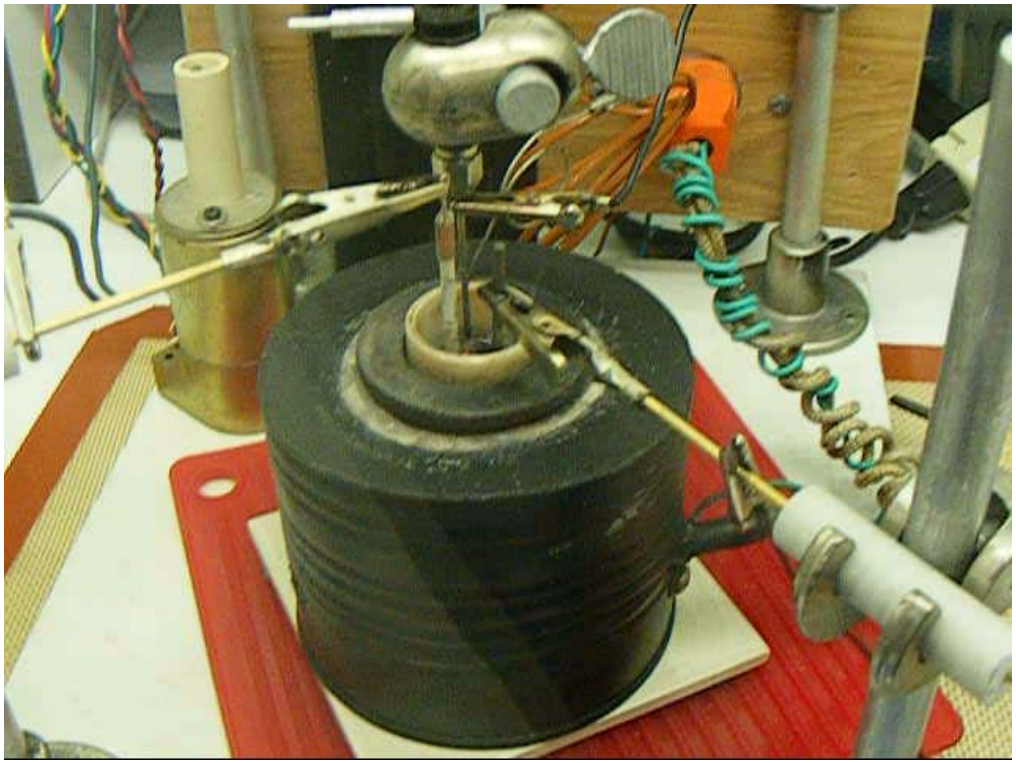

Rate of Li_2O Dissolution
OCP [V]
Time [s]
0.19
0.18
0.17
0.16
0.15
0.14
0
100
200
300
400
500
600

Lithium deposited on stainless steel electrodes

Notice silver color of Li

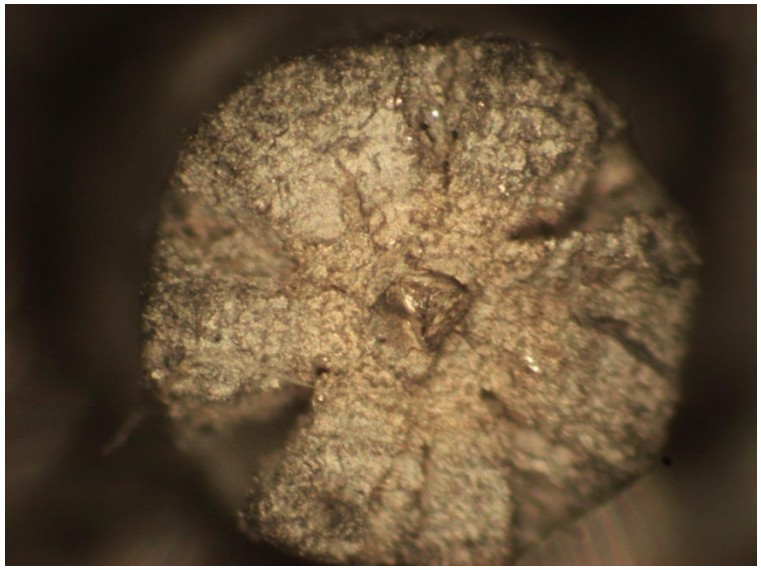
Li analysis will be easy: Gas burette for H_2 volume measurement

ELECTRODEPOSITION OF Li VIDEO
(Li glows due to oxidation with about 400ppm O_2)



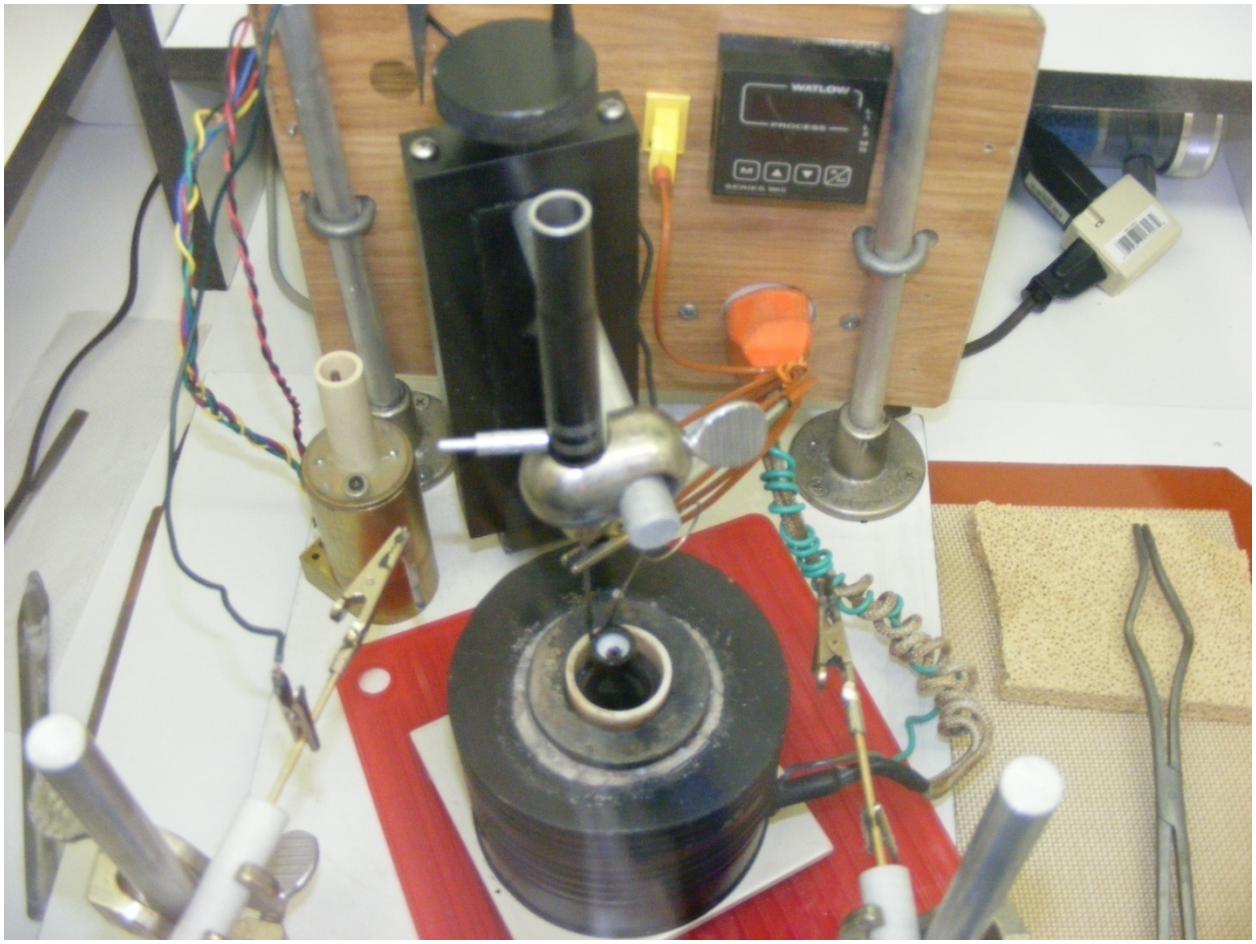
Lithium electrodeposited on Pt being dissolved in HCl solution

Li deposited on Pt does not dissolve fast



Also, Pt is severely affected by Li (and anodic potentials)

Uranium dioxide basket (cooled) pulled out after reduction



Method for measuring UO_2 reduction kinetics not yet established

FURTHER WORK

- This research is in progress
- The research will focus on studying the parameters outlined in objectives
- A method how to measure the kinetics of UO_2 reduction has to be developed (lithium is not a problem)
- The plan is to generate sufficient data, this summer, for a journal publication

Thank you very much!