Update on SE for Imaging + Engineering

Scientific Actives Division – Sample Environment Scope:

- *Provide a suite (instrument specific and pool) of Sample Environment Systems (SES) for the first 8 Instruments*
- *Maintain and evolve the suite SES incl. provision of spare SE devices*
- *Support SES users during operation*

Budgetary constraints:

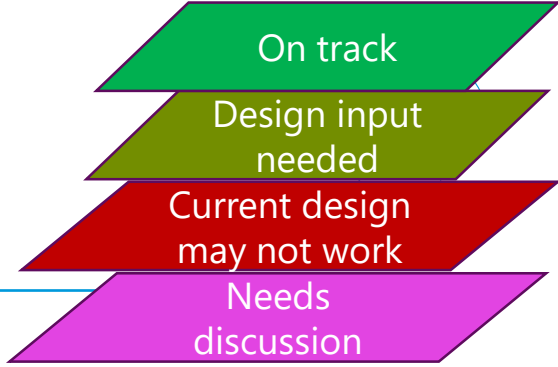
-Most In-kind committed except ~ 1 MEuros for additional Warm Bore magnets, cryostats and furnaces

-Unspent SAD Cash budget to be used for HP bunker (290 kEuros), dilatometer (400 kEuros), stress rigs (350 kEuros), refurbishment of HZB magnets & furnaces (450 kEuros)

-Investment for Critical SES : Heat gun, cryostream and induction furnace (250 kEuros)

→ SAD-SE group asked ODIN and BEER to revisit the SE pool equipment for possible use on the instrument

Update on SE for Imaging + Engineering

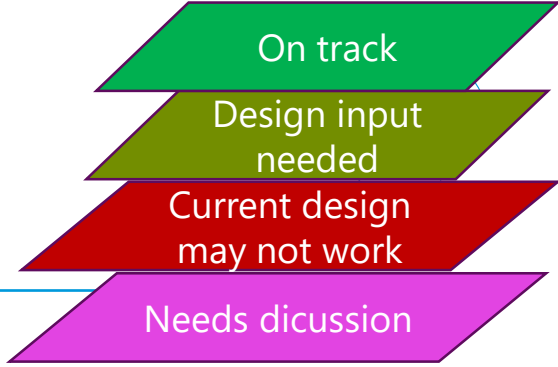


- Pool sample environment for ODIN

Sample Environment	Needed for	Priorities
Stress-Strain Rig 50 kN Tomography-rotation	HC	must have
Heatgun/Cryojet	HC	~~must have~~ can be postponed for FS
Induction furnace	FS	must have
Electrochemical cell	FS	can be postponed for SOUP
Stress-Strain Rig 100 kN	FS	can be postponed for SOUP
SANS Sample changer with same temperature individually thermalized cuvettes	SOUP	nice to have
Paris-Edinburgh Pressure Cells	SOUP	Would be nice to have for later during operation.
Diamond Anvil Cell	SOUP	Would be nice to have for later during operation.
High Pressure Clamps	SOUP	Would be nice to have for later during operation.
High Pressure Gaz cells	SOUP	Would be nice to have for later during operation.
Humidity chamber	SOUP	must have
Cryofurnace 6 Changer	SOUP	Would be nice to have for later during operation.
Flow Cells	SOUP	Would be nice to have for later during operation.
Stopped flow cells	SOUP	Would be nice to have for later during operation.
Vacuum Furnace?	SOUP	Would be nice to have for later during operation.
McGyver' I/O box	HC	Not SE. Allows ‚integration' of user equipment. Must have.

Revisit magnets and cryostats

Update on SE for Imaging + Engineering



- Pool sample environment for BEER

Sample Environment	Needed for	Priorities
100 kN Stress-Strain rig	HC	must have
Stress-Strain Rig 50 kN Tomography-rotation	HC	must have
Dilatometer	FS	
Heatgun/Cryojet	FS	can be postponed for SOUP
Induction furnace	FS	can be postponed for SOUP
High T Furnace from Chalmers	FS	Project about to start (delayed)
Electrochemical cell	?	Use cases?
Paris-Edinburgh Pressure Cells		
Diamond Anvil Cell		HP: BEER could be very suited for this?
High Pressure Clamps		
High Pressure Gaz cells		
Cryofurnace 6 Changer		
GLEEBLE		Workshop on 26 May

Update on SE for Imaging + Engineering

- Stress rig 1: Integration of stress rig 1 ongoing (since Nov 2019).
  - sent some basic commands, control, move and to read data out.
  - Set up a Beckhoff system to test timestamping and associated data file writing. Successful after some adjustments.
  - Need to finalize the syntax and define user interface exposed to NICOS.

- Stress rig 2: Procurement/Tender being finalized (https://confluence.esss.lu.se/pages/viewpage.action?pageId=341689294)

- Stress rig 3: -

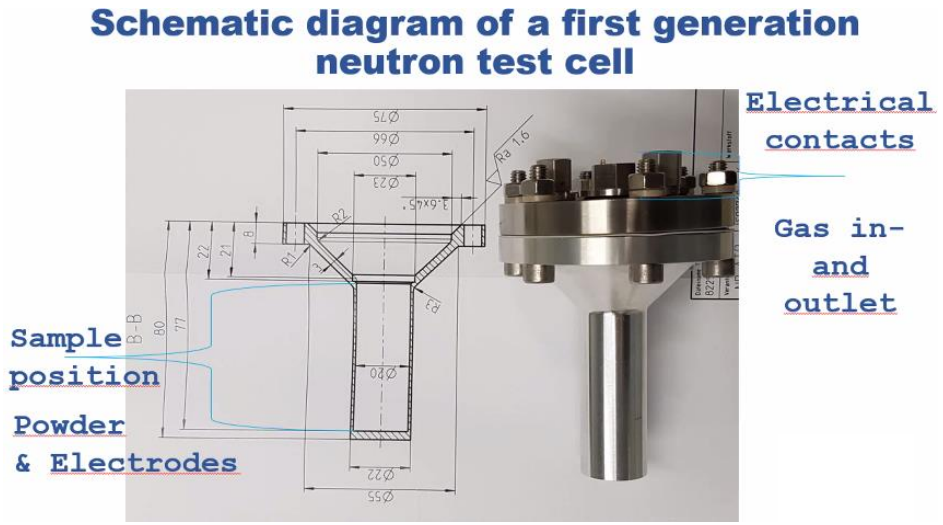
- Stress rig 4 (UTK/HZB inherited): Proposal to refurbish some HW (e.g. Laptop, cabling, connector, U-joints, ..) and also implement DIC+DVC as part of that project (collaboration with Malmo and LTH).
  - Safety review was undertaken. CE marking on commercial components sufficient. Safety guards around gears are needed.
  - Integration aspect deemed not feasible before prioritization for SE pool is in place.
  - Could run standalone (even basic TTL communication), but this is not a supported mode by ESS so far (no real integration into nexus format).

- Integration experience from SNS-VULCAN: They use commercial MTS software. Finally some EPICS integration of metadata, but used ‘temporary’ solution before. Also digital/analogue I/O modules are used.

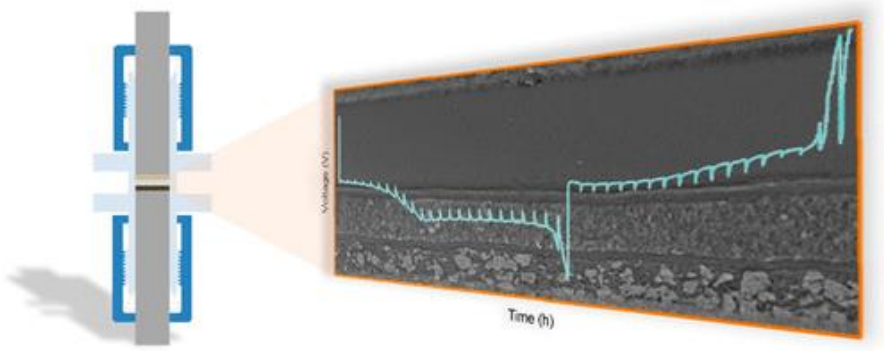
Update on SE for Imaging + Engineering

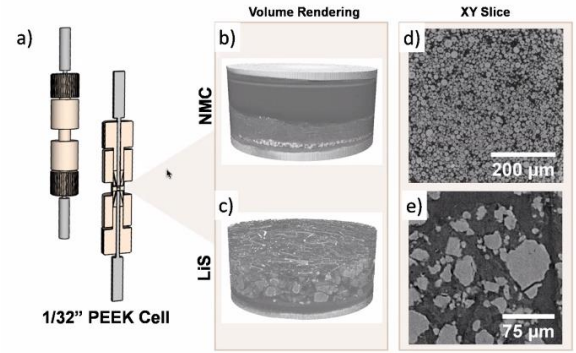
Electrochemical cell(s) for ESS user program: Explore if it can be useful for imaging?

- Meeting with two (non facility) electrochemistry 'power users': Luise Theil Kuhn (DTU) and Ralf Ziesche (Diamond, UCL)
- Two electrochemical cell projects at ESS right now. (SRESS/DREAM and Tartu cell)
- Consensus that **'first generation design' is not suitable for imaging** (tomography)
  - Maybe Ralf and Luise are too much expert users and often just doing own SE design? Talk to non-expert users, e.g. groups who are already doing electrochemistry but have no experience with neutrons?
- High resolution requirement (e.g. layered Li(NixMnyCoz)O2 (NMC) are of interest for Li batteries: secondary particle sizes between 5-20um -> need close to the detector).
- Tomography requires slip rings and careful design.



- Fairly simple swage lock design can even also work.
- Users would appreciate e.g. gas, electronics, controllers for gas valves to control gas flows, safety approval procedure (e.g. for use of hydrogen), impedance spectroscopy, glove boxes.
- Potentiostat (e.g. GAMRY 1000/5000) via triggers worked in the past. LabVIEW interface or similar desirable.
- Plan to link ESS-SE development to PhD project on neutron imaging and electrochemistry at DTU (starting in summer)



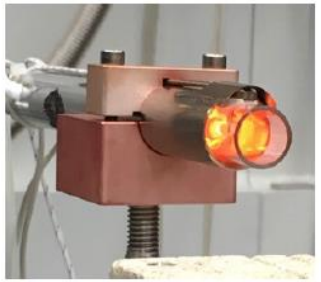


Update on SE for Imaging + Engineering

Heatgun/Cryojet & Induction furnace

NORDFORSK POSTDOC PROJECT

Design an ultrafast furnace combined with cryocooling

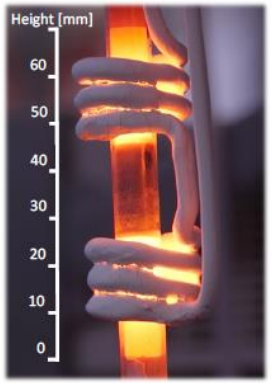


Hot-airgun

+

Cryostream

Design a ultrafast high temperature furnace

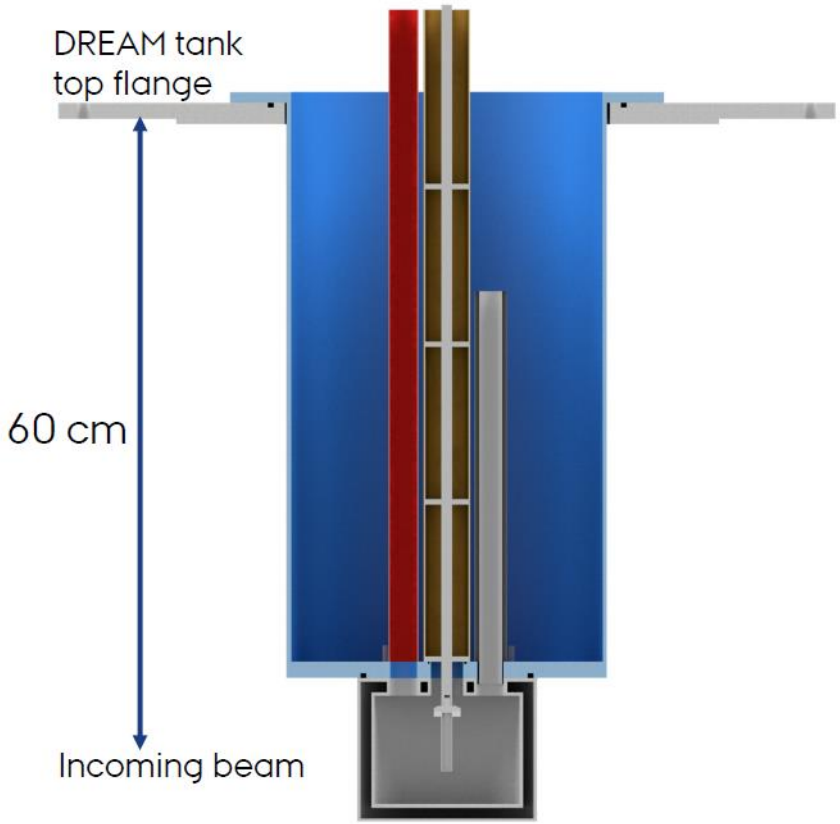


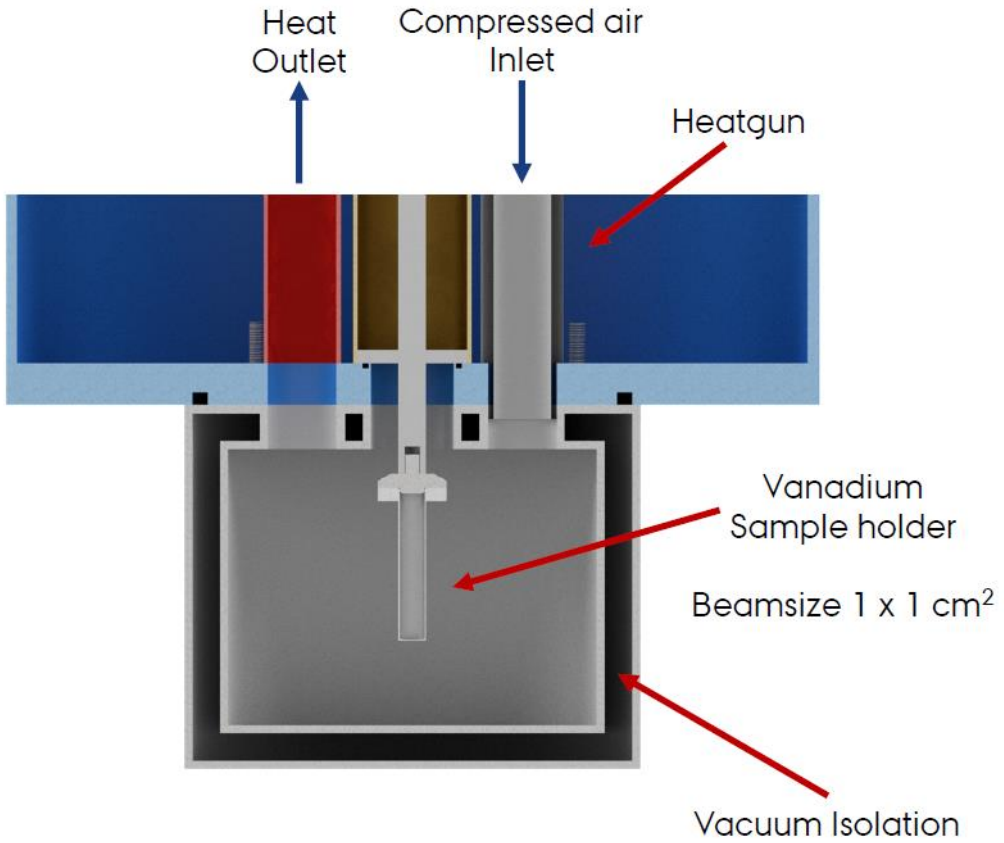
Induction

Update on SE for Imaging + Engineering

Heatgun/Cryojet & Induction furnace

PRELIMINARY DESIGN FOR DREAM (AIRGUN)





Update on SE for Imaging + Engineering

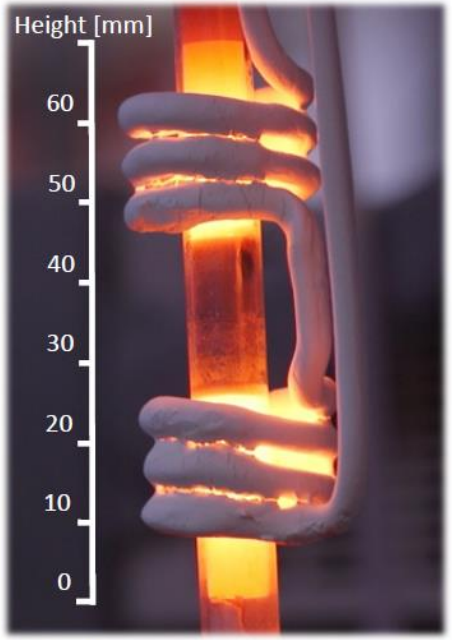
Heatgun/Cryojet & Induction furnace

AARHUS NEUTRON INDUCTION SETUP ANIS (POLARIS@ISIS)

Max Temp measured: <1500 °C

Temp Gradient ~ 5-20 %
(Temp dependent, will be uptimized (a lot) in the new version)

Thermal equilibrium < 5 min



Include sample changer

Update on SE for Imaging + Engineering

Heatgun/Cryojet & Induction furnace

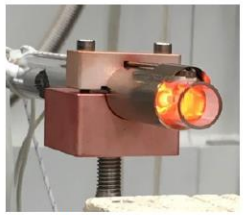
SUMMARY

Hot-airgun Cryostream

Max Temp: 1000 K
Min Temp: 10 K

Temp Gradient < 1 %

Thermal equilibrium < 5 min
Min-Max time: 15 min



Hot-airgun

+

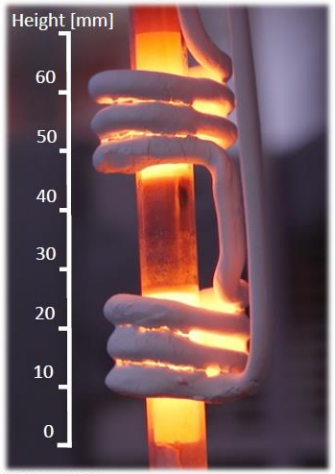
Cryostream

Induction furnace

Max Temp measured: <1500 °C

Temp Gradient ~ 2 %
(Temp dependent, will be uptimized (a lot) in the new version)

Thermal equilibrium < 5 min



AARHUS UNIVERSITY
DEPARTMENT OF CHEMISTRY

15 FEBRUARY 2021 | JAKOB VOLDUM AHLBURG
PHD STUDENT

15

Discussion with Aarhus started on how to adapt for BEER (should be ‘easy’.. some adapter to accommodate top loader for floor mounted sample environment. ODIN: some more adjustments needed, but appear possible.

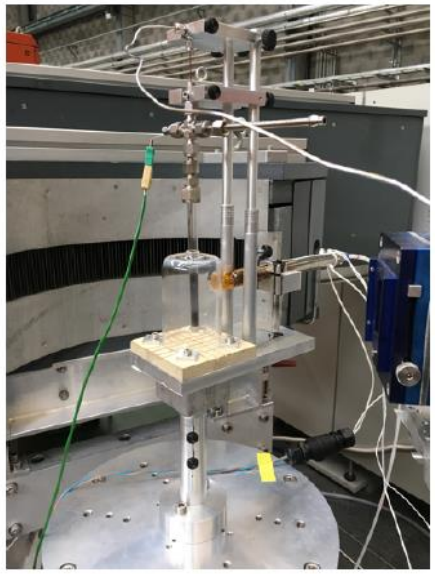
THANK YOU

Update on SE for Imaging + Engineering

Heatgun/Cryojet & Induction furnace

COMBINING HOT-AIRGUN AND CRYOSTREAM

Max Temp: 1000 K
Thermal equilibrium < 5 min



+

Min Temp: 4.5 K
Thermal equilibrium: 10 min

10-1000 K in 15 min

Include sample changer

Update on SE for Imaging + Engineering

Heatgun/Cryojet & Induction furnace