



GRIS – A Gas Release Experiment for Investigation of Hydrogen Isotopes Retention in the Metal Structures of a DEMO Blanket

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26th Technology of Fusion Energy Meeting (TOFE 2024) July 21–25, 2024, Madison, WI, USA

Motivation of this work:

Transport of Tritium (as well as other hydrogen isotopes) in the PFC (plasma facing components - blanket, first wall) in normal operation, accident conditions and decommissioning is very important for safety of future fusion reactor DEMO. Due to the importance of hydrogen permeation issues in the nuclear fusion context, this topic is a subject of research. GRIS (Gas release experiment for irradiated specimens) is developed for investigating hydrogen isotopes retention and release in relevant fusion blanket materials



Specimen container for irradiated 6 samples



Sample prepared for irradiation in reactor

3 sections each with 6 samples P92, L=60mm
D=6mm: 300/400 /500 °C
Irradiation time: appr. 1 year, achieved dose 1 dpa

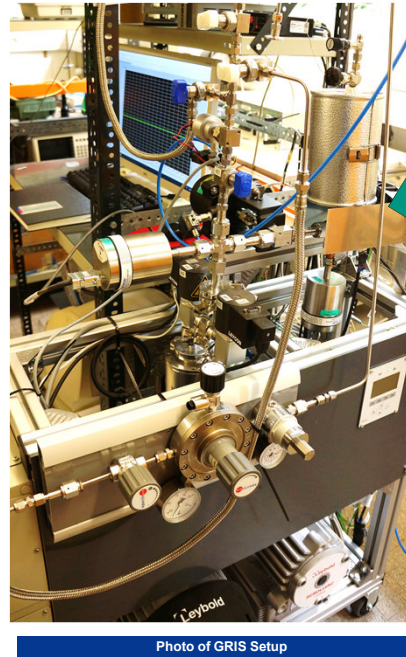
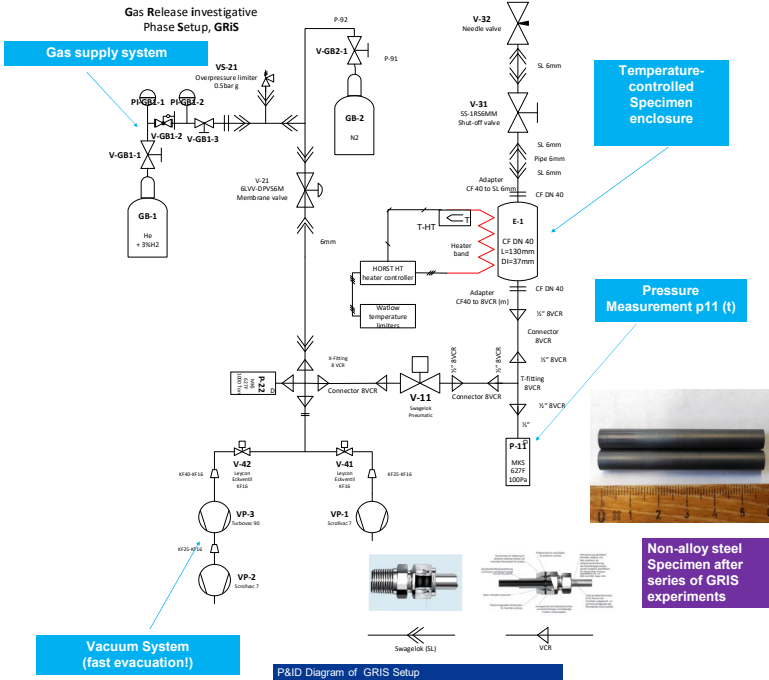
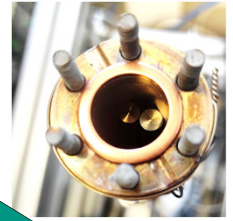


Photo of GRIS Setup

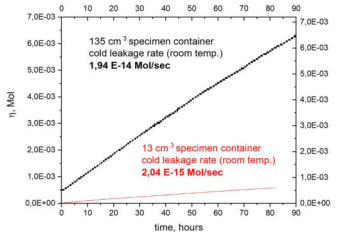


Vacuum fired specimen container 13 cm3

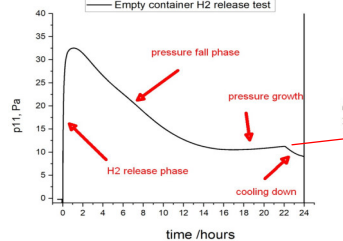
GRIS setup was developed with the perspective to be compatible with manipulator handling inside a hot-cell, where instruments must operate in the presence of gamma irradiation coming from the irradiated specimens. It is foreseen to make use of a derived setup at a reactor facility.

Results of current GRIS Experiments

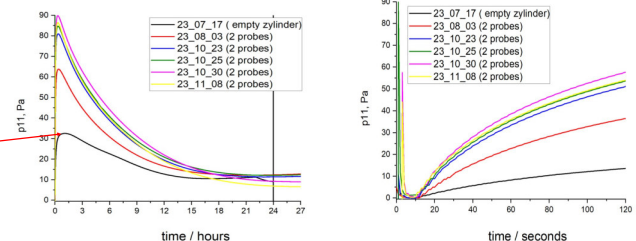
Successful GRIS tests with non-alloy steel probes. Improvement of H2 loading procedure: more accurate gas pressure control hardware



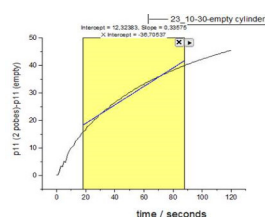
Long time cold leakage test. Comparison between 2 specimen containers



Pressure P11 vs. time diagram for H2 release experiment with specimen container without probes



Pressure P11 vs. time diagram for H2 release experiment with specimen container with 2 non-alloy steel probes (2 time scales)



Rough extrapolation for the pressure difference p11 (2 probes)-p11 (empty container)



Non-alloy steel Specimen after series of GRIS experiments

Conclusions

- The GRIS experimental setup was developed, constructed and successfully taken to service.
- A number of outgassing experiments at 450°C as well as leakage tests were accomplished
- Successful first hot gas release experiments with non-alloy steel samples inside vacuum fired specimen container were performed.
- A comparison to results without samples found a usable signal to noise ratio and a promising reproducibility. Both are prerequisites for evaluation of hydrogen transport diffusion parameters. Post experimental check of the specimen was carried out.
- As consequence of experiment results, the improvement of H2 loading procedure: more accurate gas pressure and H2-loading time as well as evacuation control hardware will be implemented - manual valves will be replaced by pneumatic ones controlled via Labview sequence for the experiments

After the tests, post experimental investigation of specimen container and metal specimens was carried out. Further enhancement is expected by applying of a smaller specimen container with glass walls for the near future

