

Taking to Service and First Results of the Q-PETE/D2 Hydrogen Permeation Setup

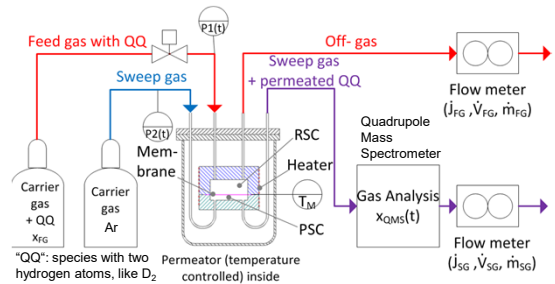
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Background and Objective

The experiment "Q-PETE/D2" representative for the situation in the Helium Cooled Pebble Bed breeding zone (flowing purge gas with ~400Pa hydrogen) and suitable for validation of relevant tritium transport codes has been constructed and taken to service.

In a temperature controlled setup a hydrogen loaded feed gas is directed over a steel membrane into which it can permeate.

On the other side of the membrane a sweep gas flow collects the permeated hydrogen and transports it to a gas analysis (QMS) for quantitative time resolved detection.



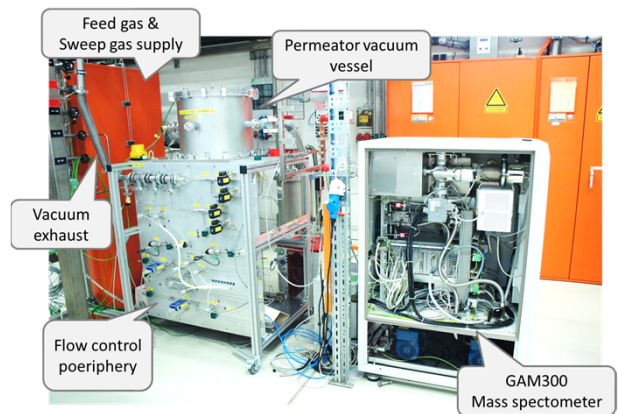
Schematic flow and instrumentation diagram of Q-PETE

First experimental campaign 01/2019 - 07/2019

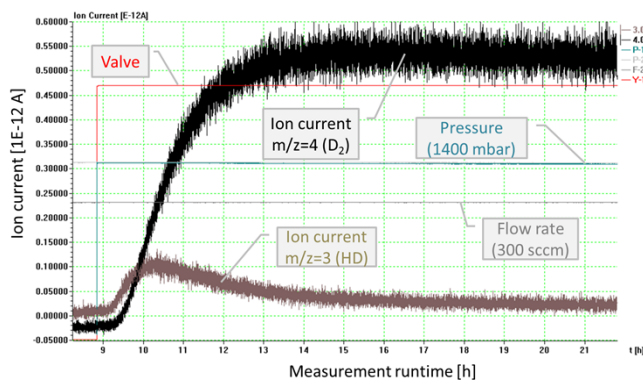
- Membrane made of 316L (X2 CrNiMo 17 12 2), thickness 1.14mm
- Deuterium concentration 3000 ppm, pressure 1400 mbar abs.
- Temperatures between 300 and 550 °C, 85 documented runs.

Observations

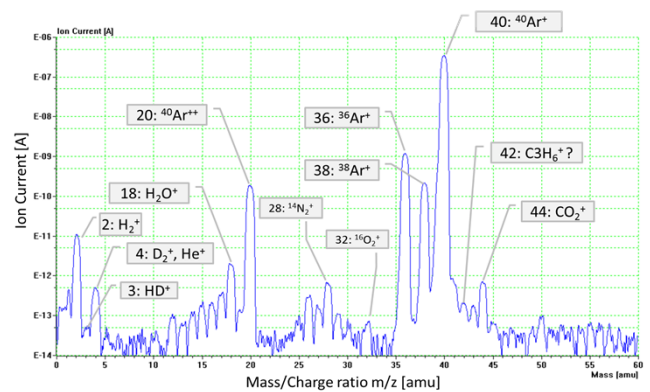
- The Ion-current signal $I(m/z=4)$ (D_2) follows the expected evolution
- The signal at $I(m/z=3)$ (HD expected) is not proportional to $I(m/z=4)$: It peaks during the rise time of $I(m/z=4)$ and saturates on lower level
- For repeated experiments at 400 °C, 300 sccm, the diffusion/permeation degraded noticeably. (Membrane surface darkened probably due to a trace hydrogen carbon)
- Derived diffusion and permeation data agree well with the range found in literature.



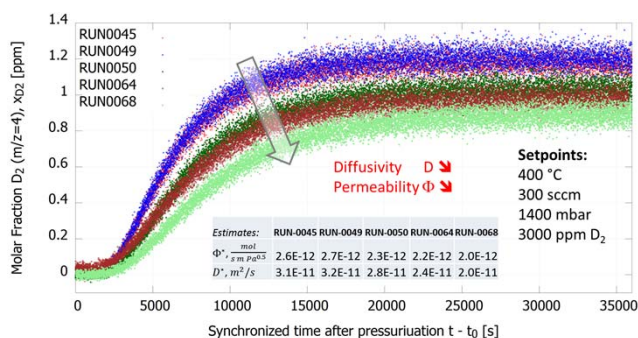
Installation of Q-PETE/D2 at KIT-INR HELOKA-LP facility



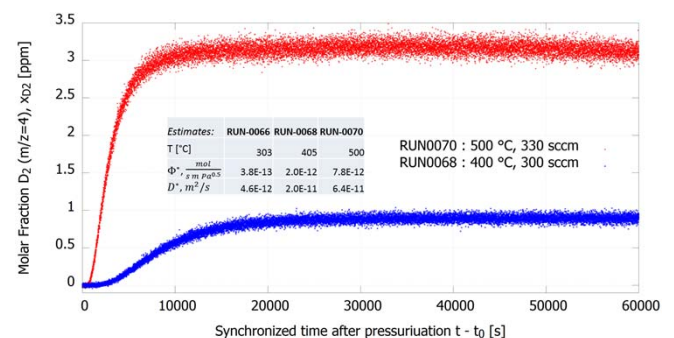
Multiple Ion Detection (MID) data, Q-PETE RUN045 (316L, 400°C)



Mass spectrum (Scan 1-60) data, Q-PETE RUN045 (316L, 400°C)



Experiment repetitions at 400 °C, 300 sccm (show degradation)



Variation of temperature: 400, 500°C)