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

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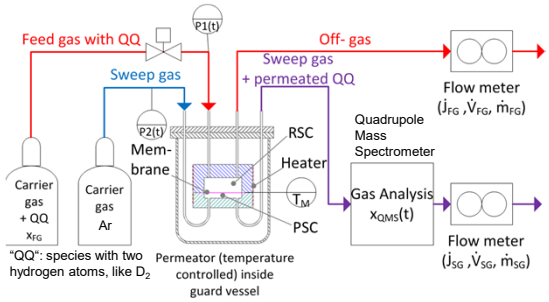
Background and Objective

*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.*

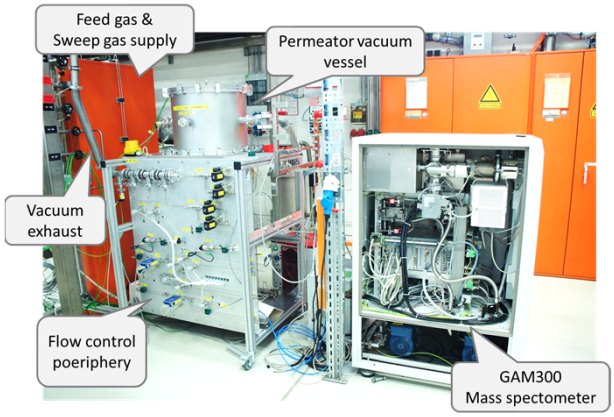
In a temperature controlled setup a hydrogen loaded feed gas is directed over a steel membrane into which it can permeate.
*On the other side of the membrane **a sweep gas flow collects the permeated hydrogen** and transports it to a gas analysis **(QMS)** for quantitative **time resolved detection**.*



Schematic flow and instrumentation diagram of Q-PETE

First experimental campaign 01/2019 - 07/2019

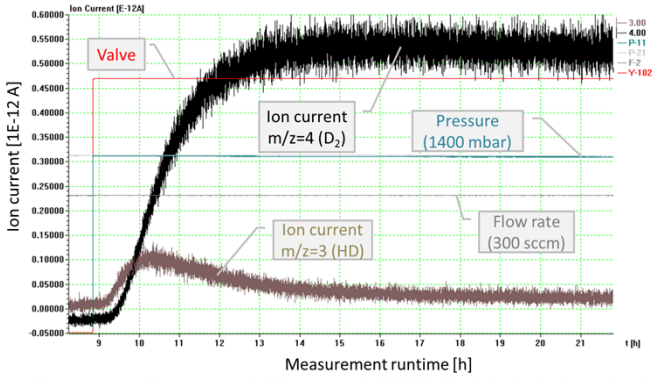
- Membrane made of 316L (X2 CrNiMo 17 12 2), thickness 1.14mm
- Deuterium concentration 3000 ppm, pressure 1400 mbar abs.
- Temperatures between 300 and 550 °C, 85 documented runs.



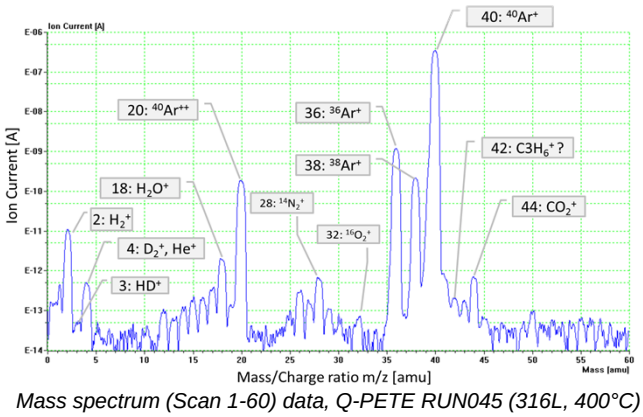
Installation of Q-PETE/D2 at KIT-INR HELOKA-LP facility

Observations

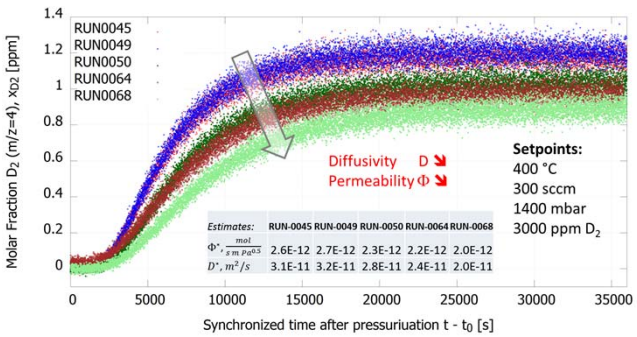
- The Ion-current signal I(m/z=4) (D_2) follows the expected evolution
- The signal at I(m/z=3) (HD expected) is not proportional to I(m/z=4): It peaks during the rise time of I(m/z=4) and saturates on lower level
- For repeated experiments at 400 °C, 300 sccm, the diffusion/permeation degraded noticeably.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



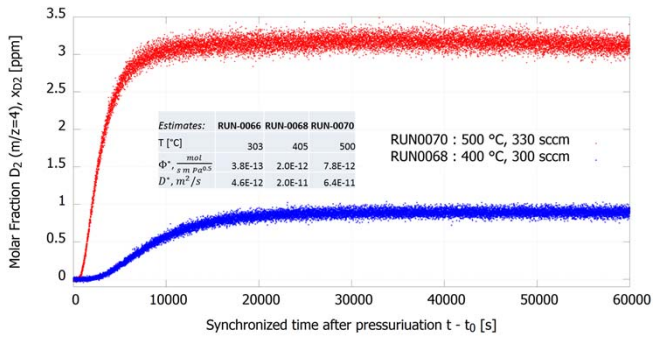
Multiple Ion Detection (MID) data, Q-PETE RUN045 (316L, 400°C)



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)

EUROfusion

This work has been carried out within the framework of the EUROfusion Consortium and has received funding from the Euratom research and training programme 2014-2018 and 2019-2020 under grant agreement No 633053. The views and opinions expressed herein do not necessarily reflect those of the European Commission.