SWERIM
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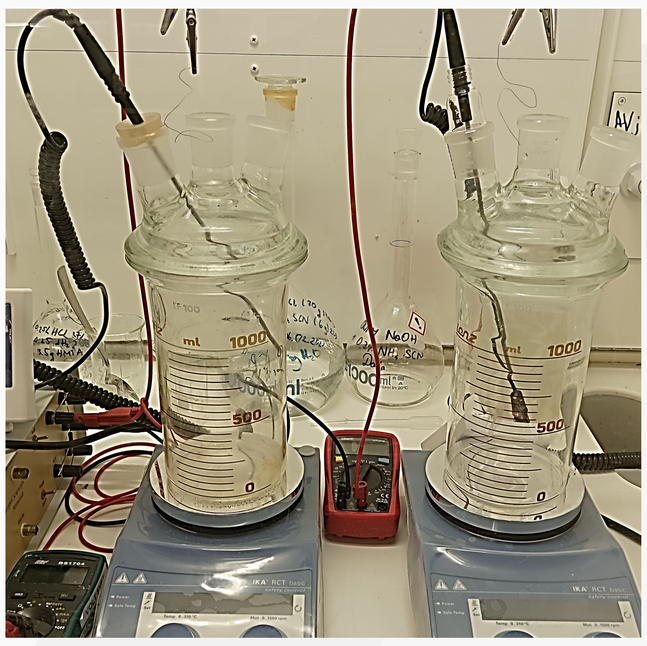
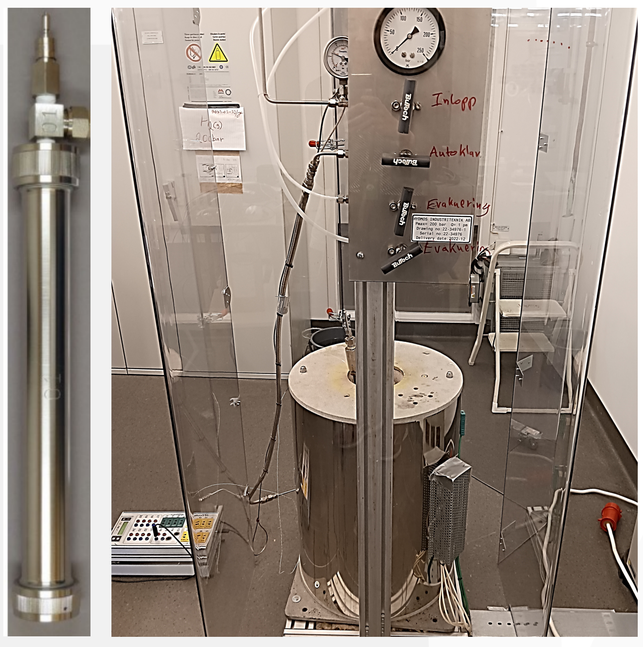
Hydrogen-related measurements

How is hydrogen artificially introduced into metals?



Cathodic charging in electrochemical cell

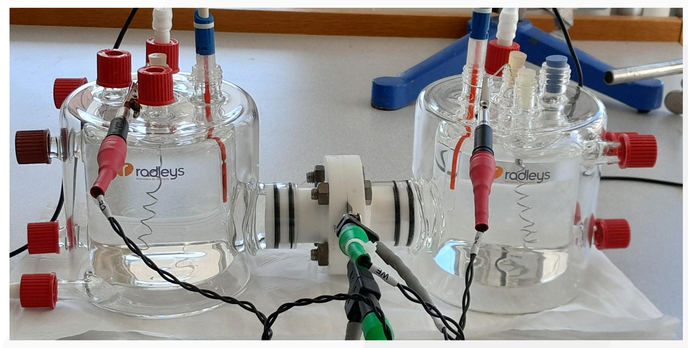
- In an electrochemical cell, the sample acts as as a cathode and a Pt counter electrode as an anode.
- By applying a cathodic current to the sample, hydrogen is created on the sample surface and diffuses inside the material.
- Recombination poisons, time and increased temperature can be used to increase the hydrogen introduction.
- Sample size: 10x20x60 mm.

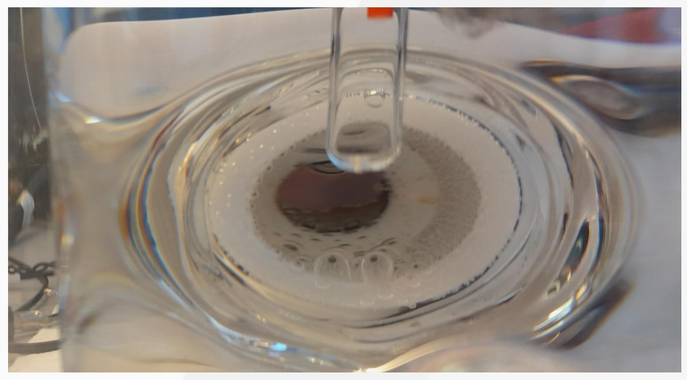


Gas charging in autoclave

- Samples are exposed to hydrogen gas under high pressures and high temperatures.
- Used for pre-charging specimens and/or for evaluating the effect of microstructure, coatings and deformation on hydrogen uptake.
- Maximum temperature: 900 °C, maximum pressure: 300 bar.
- Sample size: <= 10x10x150 mm.

How is the diffusion of hydrogen in metals measured?

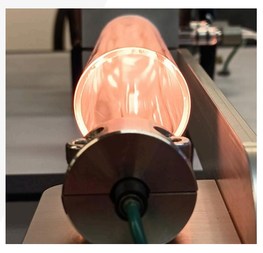




Devanathan cell – electrochemical measurement of diffusion coefficient of hydrogen in metals

- Hydrogen is produced in one cell filled with an electrolyte solution and detected in another.
- Both cells are separated by a thin plate of the metal to be characterized.
- The measured amount of permeation current allows conclusions about the diffusion rate of hydrogen through the metal plate.
- Sample size: Diameter 15x1 mm.

How is the hydrogen content in metals measured?



Thermal Desorption Mass Spectrometry (TDMS) – Quantification of hydrogen in metals

- TDMS using a Bruker Galileo G8 spectroscope with integrated impulse furnace and coupled with mass spectrometry MS.
- Total hydrogen content (melt extraction): The samples are melted in a graphite crucible. Resulting gases are analyzed using a mass spectrometer.
- Diffusible and deeply trapped hydrogen content (tube furnace): samples are heated up with a certain heating rate and gases analyzed with MS.
- Accuracy: ca. 10 ppb hydrogen.
- Sample size: Total hydr.: ≤ 4x4x4 mm, diffusible hydr.: ≤ 20x20x60 mm.

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