

EMIRI TechTalk: Advanced materials for clean hydrogen production by electrolysis

Wrap up morning session



Warm thank you to the speakers:

Prof. Luigi Crema

Dr Julie Mougín

Prof. Stefan Loos

Dr Aldo Gago

Prof. Tom Smolinka

And to the organizers: **Karim, Fabrice, Philippe and Gemma**

REPowerEU

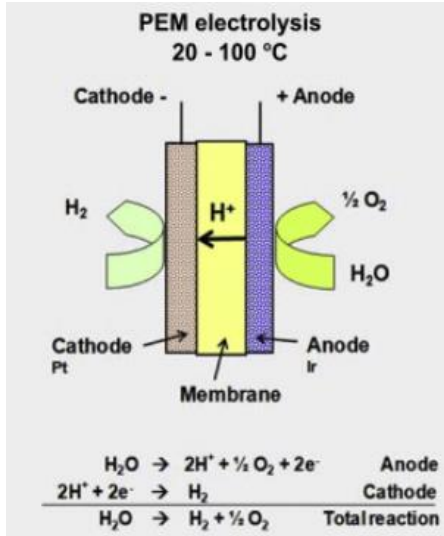


A **Hydrogen Accelerator** to develop infrastructure, storage facilities and ports, and replace demand for Russian gas with additional 10 MT of imported renewable hydrogen from diverse sources and additional 5 MT of domestic renewable hydrogen.

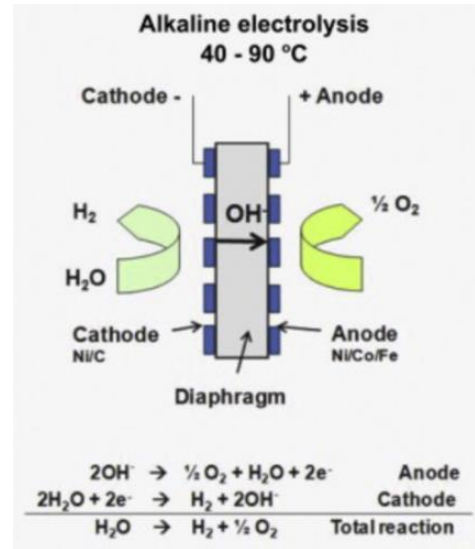
Impact on installed electrolysis: EU has just multiplied by 4 its target for 2030 (now at 160 GW of electrolyser capacity to cut ties with fossil fuels).

The 4 technologies at a glance

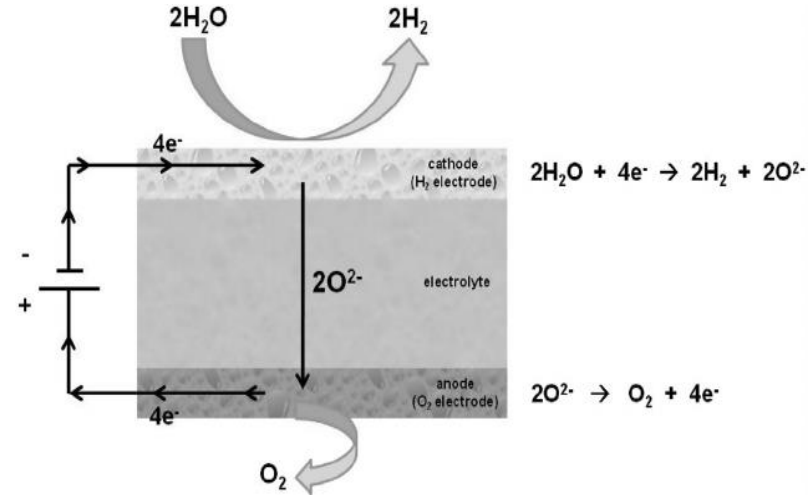
PEM



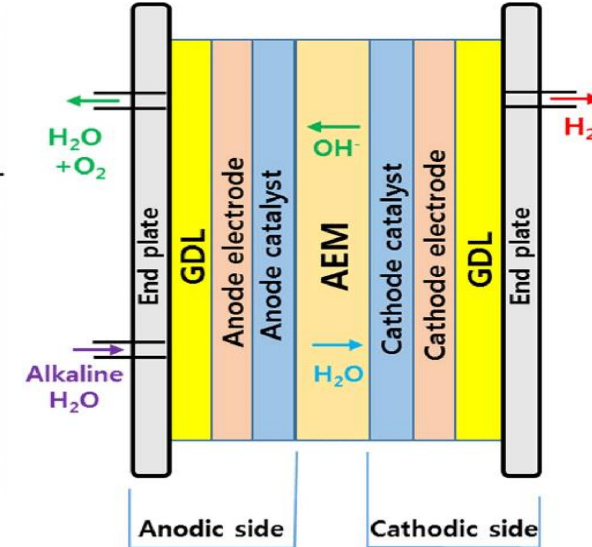
AEL



SOEC



AEMEL



Ref.
<https://doi.org/10.1016/j.ijhydene.2013.01.151>

<https://www.huceg.org/journal/green-hydrogen-solar-driven-water-splitting-and-optimization>

Nechache et al, Solid oxide electrolysis cell analysis by means of electrochemical impedance spectroscopy: A review, 2014, Journal of Power Sources

Ref. Janget al, Journal of the Korean institute of surface engineering

Advanced materials are key to further development and upscaling of the electrolysis technologies

Improved advanced materials are needed to tackle the main challenges of the different technologies

PEM:

State-of-the-art Advanced Materials:

- At the cathode, platinum is usually used and at the anode, iridium or ruthenium oxide are used
- Bipolar plates are made of Titanium (or a titanium coating)
- Most common materials used by proton exchange membrane manufacturers are based on PFSA (Perfluoro Sulfonated Acid) structure

Novel materials are a.o related to:

New membranes, new catalysts (support, composition, morphology, functionalization..),
new coatings on bipolar plates....

AEL:

State-of-the-art advanced Materials:

- Diaphragms are classically made of zirconia and polysulfone.
- The electrolyte is potassium hydroxide (KOH, 20-40 wt%).
- The anode and cathode are usually made of Nickel (e.g., Ni-Mo alloys for cathode and Ni-Co alloys for anode).

Novel materials are a.o related to:

Materials that lower Oxygen overpotential, novel catalysts (composition, morphology ..), novel membranes, corrosion resistant materials....

SOCE

- **State-of-the-art advanced Materials:**

- The most used materials for SOEC cathodes and anodes are respectively is nickel-doped yttria- stabilized zirconia, or Ni:YSZ and Strontium-doped lanthanum ferro-cobaltite (LSCF) $\text{La}_{1-x}\text{Sr}_x\text{CoFeO}_3$.
- The electrolyte used classically is yttria-stabilized zirconia (YSZ).

- **Novel materials are related to:**

New electrodes / composition of materials, resistant high temperature electrodes , new electrolyte / composition of materials.....

AEMEL

State-of-the-art advanced Materials:

- Cathode materials are usually made of Ni and Ni alloys and anode with Ni, Fe, Co (hydr) oxides.
- The membrane is composed of a quaternary ammonium ion-exchange-group.

Novel materials are related to:

Development of robust catalyst layers (Ni-Mo based), development of stable alkaline exchange membrane, membrane and ionomer development, porous transport layer development....

Conclusion

- All these advanced material aspects will be further discussed in detail in the afternoon session between EMIRI experts.