Metal hydride based optical hydrogen sensors

a hydrogen detection solution that detects and quantifies hydrogen presence using optical detection with metal-hydrogen interaction. The way the technology is set up, sensors can be developed to operate well in traditionally difficult environments, such as very high or low hydrogen concentrations, mixed gases, and much more

Problem

Moving towards a hydrogen economy
When moving to a renewable energy transition, hydrogen will play an important role as an energy-carrier. Applications could range from chemical processes, storage, fuel, high temperature industrial application and many more.

Need for sensing to ensure safety and efficiency
In the hydrogen economy it is important to detect and measure hydrogen concentrations. Unwanted hydrogen presence could lead to safety risks, cause excessive greenhouse gas emissions and be a signal for operational losses. Therefore, everywhere where there is hydrogen it is essential to have a well-functioning sensing system to detect potential presence and act accordingly.

Existing sensors have costly imperfections
There are several existing sensor technologies that exist, each having their own strengths and weaknesses. Based on our research, we believe that optical hydrogen sensors can compete with catalytic, electrochemical, and thermal conductivity sensors. To determine opportunities for system improvement with our breakthrough solutions, the fundamental capabilities from the technology have to be compared with the golden-standard that is applied.

Solution

Optical thin-film hydrogen sensing
A thin-film metal hydride that absorbs hydrogen molecules, combined with an optical fibre read-out solution. The metal hydride can be seen as a sponge, combined with the optical detection solution that will accurately measure how much the sponge has absorbed.

Solving bottlenecks in:
Electrolyzers / fuel cells; Existing sensors in electrolyzers often experience drift, leading to inaccurate hydrogen concentration data. This requires recalibration about twice a year to maintain safety. The drift also prevents operators from acting on small changes in hydrogen levels, limiting their ability to optimize the hydrogen production process.

Hydrogen (gas) transport; Hydrogen gas (can be transported mixed with natural gas), requiring accurate concentration monitoring and leak detection. However, high hydrogen levels, cross-sensitivity of gases and limited access for calibration restrict sensor use.
First experiments testing in such CH4/H2 environment have shown great results, aligning with our assumption that our metal hydride solution's fundamental solution works particularly well in such environment..

Potential other markets identified: hydrogen storage, aviation, general application market (through wholesalers).

About the technology

TRL: : 3-4 (several validation steps have been done, but depending on the decided market segment and associated product design requirements further validation might have to be done)
Patent status: EU patent granted, US patent application published (WO2022098230), second patent in application
Department: TNW, Reactor Institute, Storage of Electrochemical Energy
Team: TU Delft: Lars Bannenberg & Herman Schreuders **- Ideation labs:** Thomas Rous

Reduce total cost of ownership
for end-users because of increased lifespan, little to no calibration requirements

Unlock the value of data
because of fast, reliable, granular data

Application-specific tailoring
sensing platform can be developed and tweaked to make application-specific sensors

We are looking for:

Financing
to perform application-specific pilots and prototyping

Network
ydgrogen infrastructure experts, electrolyzer & fuel cell developers and users, investors

Next steps

- ✓ Continued collaboration between Impact Studio Customer Discovery Support team, Optical Hydrogen sensor team and Thomas
- ✓ Explore and quantify business case further
- ✓ Build focus-group with experts and end-users to determine product and evidence requirements for adoption
- ✓ Find investors for co-financing university spin-off

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