OPTHYCS

N°1 - September 2024

NEWSLETTER

INTRODUCTION

The OPTHYCS project aims to develop a new optical fibre sensor technology that will lead to an increase in the safety level of H_2 applications, as well as minimize potential H_2 releases to limit the climate impact of H_2 uptake.

In this Newsletter

Clean Hydrogen Partnership

Co-funded by the European Union

This project has received funding from the Clean Hydrogen Partnership under Grant Agreement No 101101415. This Partnership receives support from the European Union's Horizon Europe Research and Innovation program, Hydrogen Europe and Hydrogen Europe Research.

A SIGHT TO THE PROJECT

Hydrogen is emerging as a key commodity needed for the decarbonization of the generation, distribution, storage, and energy consumption. Through the EU Hydrogen Strategy, the European Commission recognises the important role of hydrogen, and the need for the hydrogen market to be significantly scaled up.

This expected boost in H_2 production and its introduction in the energy market raises one important issue: leakage of H_2 during its storage, transportation, and distribution.

The OPTHYCS project aims to develop a new sensor technology which will lead to an increase in the safety level of H_2 applications, as well as minimising potential H_2 releases to limit climate impact of H_2 uptake, from production to storage and distribution, both in new infrastructure, working with pure H_2, and in natural gas repurposed installations and pipelines, contributing to a safe and economically viable implementation of H_2 production, transport, and storage processes.

KEY TECHNOLOGY PILLARS (KTPs)

The OPTHYCS project is built upon 3 conceptual areas: the "**Key Technology Pillars** analysis and definition of the new sensor technology", the "**Validation of key use cases** in which the capabilities and reliability of the new tested technologies will be proved in controlled situations and the "**Aspects of the technologies** derived from the use cases".

Based on the 3 conceptual blocks defined, OPTHYCS will bring a step forward within the H_2 leakage detection, quantification and awareness compared to current state-of-the-art (SoA) for the technological developments.

Key technology pillar (KTP) 1. Hydrogen sensors based on optic fibre

New coating materials for Fibre Bragg Grating (FBG) sensors

At present, there are different types of H_2 sensors and it is necessary to choose a suitable one for a specific application based on the working environmental conditions, the detection requirements and performance capabilities of the sensor.

Since H_2 molecules cannot be detected by the spectral absorption method, using materials that can react with H_2 is critical for H_2 detection technology.

In the past, several coatings with different configurations of FBG sensors have been developed at experimental level. However, the developed technologies have different capabilities in terms of H_2 concentration detection, repeatability and resiliency, precision with humidity or ambient temperature changes, and presence of other gas molecules, not valid for the end use cases established for this project.

For that reason, the OPTHYCS team is working on finding a chemical coating that can measure from low to high levels of H_2 concentration in the air, for all the environmental conditions with resiliency to measure along the life of an asset with sufficient repeatability and testing of sputtering.

Sensor coating development will pursue the objective of obtaining a precise measurement of H_2 ppms, H_2 (at ppm level) in gas mixtures (with methane), from low the ppm levels to high ppm levels (High sensitivity), for a wide operating temperature range (of H_2 Midstream sites or Aerial Pipes), and for low and high atmospheric pressures, also for humid environments.

The objective is to obtain a New H_2 FBG sensor with a coating sensitive to the detection of H_2 in air at low and high ppms for different gaseous mixtures, environmental conditions, and measurement repeatability.

Combination of Bragg grated sensors with distributed FO sensors

Fibre Optic Sensing applications are divided into two major groups: A) **Critical Location and Semi-Distributed** (Sensors in Array), where the signals are multiplexed by time or by wavelength, and B) **Distributed Sensing**, the spatial resolution is given by the capability of measuring the reflection of the scattering process by time.

OPTHYCS will combine the signal of the two groups of monitoring technologies: critical location based on FBG to develop a new H_2 ppm detection sensor and DAS and DTS to monitor long linear distances and assets with pre-installed fibre such as underground pipelines.

KTP 2. DATA ACQUISITION AND INTERROGATOR SYSTEMS

Fibre Optic measurement Interrogators are divided into groups depending on their technological base and light property processing capability (Faraday, Rayleigh, Fibre Bragg Grating (FBG), Raman, and Brillouin). For the specific detection of H_2 molecules and their concentration (ppm), the only existing interrogators that have a technological base to give a direct measure are FBG interrogators. This technology measures the change of the light periodic or aperiodic disturbance of the effective refractive index produced in the core of an optical fibre. Hence FBG interrogation methods are classified by frequency measurement.

OPTHYCS focuses on the development of an H_2 FBG Application interrogator, that can integrate enough H_2 detection sensors, at the required distance (Gas Pipeline Critical Sensing Points from interrogator), with the required sensitivity and real-time.

The goal is to obtain a fast processing, highly sensitive, multi-sensor, long range, H_2 leak detection FBG Interrogator.

KTP 3. SOFTWARE SOLUTIONS

FEBUS Optics has already developed several advanced data processing to detect abnormal temperature variation on cable (RTTR), pipeline leak detection (RUSH) and event recognition (Machine Learning). Alarms are managed by the FoGuard software solution, that are currently valid for other applications such as crude oil and waterfalls.

To go beyond the current uses and adapt to H_2 leak detection, the FBG interrogator will contain 3 SW levels.It will process the lights signals from the new H_2 detection sensors and provide a value of detected H_2 ppms over a period. Knowing the gas concentration, with this data it will be possible to analyse where there is a H_2 leak, and what flowrate it has, from the new FrontEnd SW developed by FEBUS Optics.

PARTNERS OF THE CONSORTIUM

enagas

FEBUS optics

GERG THE EUROPEAN GAS RESEARCH GROUP

Ha FOUNDATION FOR THE DEVELOPMENT OF NEW HYDROGEN TECHNOLOGIES IN ARAGON

Qumiker

tecnalia MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

GRTgaz

CONSORTIUM MEETING IN MADRID

OPTHYCS team in Madrid, Spain. Consortium meeting at the premises of Enagás (September 2023)

Meeting the Consortium

ENAGÁS: three questions with **Violeta Bescos Roy**

Technology Development and Innovation Lead, innovation department of Enagás.

1. **Why is this project important for you?**

This project aligns with our commitment to environmental sustainability and safety. Addressing hydrogen emissions ensures the safe utilization of this clean energy source, reflecting our dedication to maintaining the highest standards. In supporting innovating initiatives on H_2 emissions, we aim to position our company to drive positive change within the industry.

The minimization of hydrogen emissions is emerging as crucial for the future energy sector. The final text of the H_2 Directive and Regulation, that came into force this year, shows the relevance of this topic, specifying the need to minimize leakage from hydrogen systems. This regulatory framework stablishes obligations for hydrogen networks, storage and terminal operators to minimize hydrogen emissions and to carry out regular leak detection and repair surveys.
Also, it is expected that the future European Network of Hydrogen Network Operators (ENNOH) will include the development and promotion of best practices in the detection, monitoring and reduction of H_2 releases as part of its tasks. Thus, we envisage that the detection system developed within this project will be a valuable tool for future H_2 operators, contributing towards a net-zero future.

2. **What is, in your opinion, the biggest challenge of this project?**

In my opinion, the most substantial challenge of this project lies is the integration of various detection technologies, the combination of FBG point sensors and DAS/DTS distributed sensing is an innovative approach that hasn't yet been previously developed. The firsts tests are currently taking place and are crucial to pave the way for the appropriate project execution and to achieve the desired outcomes.

3. **What is your role in the OPTHYCS consortium?**

As the coordinator of the OPTHYCS consortium, my role is to oversee and facilitate the collaborative efforts of the participating members. I am responsible for ensuring effective communication, project management, and the overall success of the consortium's objectives. This involves coordinating activities, fostering collaboration, and serving as a central point of contact for all consortium members.

In addition to this, from the technical perspective Enagas provides input as potential end user regarding the requirements of the detection system and we will lead part of the field tests scheduled within the project.

Follow us on

LinkedIn