As the globe shifts towards more green energy solutions, a key fuel will be needed to sustain our hunger for energy: hydrogen; a renewable source of energy, it has broad applications and the potential to change entire industries, particularly in the shipping industry which generates 3% of global greenhouse gas emissions.

An important step in achieving this is in the safe storage of hydrogen and building compatible sensors to ensure if something does go wrong, we know immediately when and where that occurs; fibre optics can be a part of this solution, as unlike electrical sensors, they cannot spark and therefore mitigate any risk of explosion or fire, in addition to being incredibly sensitive and compact, and can also be multiplexed (meaning multiple sensors can be placed along a single cable).

Our research focuses on creating these sensors, with fibre optic cables we use advanced fibre Bragg gratings (FBG's) which in a basic sense are repeated defects we induce in a section of the glass (the sensor) that reflects/transmits light of different wavelengths in a repeatable way.

When we change the external environment, this spectrum of different wavelengths changes, and with simple FBG's we can detect things like temperature, strain, or pressure; with the use of advanced FBG's however (in our research, Pi-shifted FBG's) and by applying coatings of different materials (such as palladium, polyimide, graphene oxide, etc.), it opens up a whole new world of sensing capabilities: sensors for humidity, pressure, chemicals, enzymes, proteins, and more--like hydrogen.

By using these advanced fibre gratings (Pi-shifted FBG's) and coating a portion of the sensor with a layers of nickel, nickel palladium, platinum palladium, and PTFE, hydrogen concentration and temperature can be measured simultaneously; as palladium absorbs hydrogen from the air, it swells like a sponge, squeezing the sensor asymmetrically, such that a portion is unaffected (sensitive to temperature only), while the affected portion can be correlated to hydrogen concentration allowing the two parameters to be uniquely distinguished.