Chromacity

Photonic Solutions to Climate Challenges

A short article by Dr Christopher G. Leburn, Commercial Director & Co-founder – September 2022

We know our climate is changing. What is less clear is how we can quantify these complex changes in a robust and scientific way that helps to mitigate the effects or even reverse the damage caused. Something we have a collective responsibility for.

There is no doubt that this is a global challenge, and all nations need to work collectively to develop solutions. In Scotland, we have our own part to play, and we are at the forefront of developments in renewable energy production. This started with hydroelectric facilities in Kinloch Leven and Lochaber back in 1934 but more recently developing technologies that harness the power of wind and tide. However, one of the most important developments in recent years has been to explore the benefits of clean hydrogen technologies.

Photonics plays a significant role in not only understanding how greenhouse gasses leak into the atmosphere but also integrating optical solutions to help generate cleaner energy and increasing the efficiency in manufacturing processes, all with a view to reducing emissions.

Chromacity has been at the forefront of combining its broad bandwidth tuneable laser sources with high resolution interferometers, to create FTIR (Fourier Transformed Infrared) capabilities that allow the qualification and quantification of a wide number of environmentally important chemical signatures. These lasers emit coherent, high brightness, broad bandwidth laser light across spectrally important wavelengths, typically in the mid-infrared (mid-IR).

Initial work looked at detecting hydrocarbons using a technique called stand-off detection. The broad bandwidth of the laser source allows simultaneous detection of important hydrocarbons such as methane and ethane, as well as CO_2, CO, and other environmentally important gases at distances of several hundred meters with parts per billion sensitivities [1].

This is an important technique which can be used in multiple environmental sensing applications. As an example, monitoring stack emissions within industrial sites or the emissions from landfill sites will become increasingly prevalent as new government legislation is brought in to reduce emissions, or the detection of contaminants within the production or transport of hydrogen.

Further consideration on the benefits of being able to qualify and quantify the chemical signatures from solids and liquids should be given. In the gas phase, most molecules have narrow chemical signatures, but in the solid and liquid phase these chemical signatures broaden. There are a range of techniques that are currently used but these have limitations such as producing weak signals based on the power of the technology used and others increase the probability of contaminating the sample. This is where Chromacity's tuneable lasers bring a number of benefits over legacy Technologies and indeed similar techniques using technology that does not have the same characteristics as the Chromacity OPO (Optical Parametric Oscillator) tuneable laser sources.

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Our work in 2018 used the FTIR (Fourier Transformed Infrared) technique to identify a variety of white powder samples, including painkillers, amino acids, stimulants, and sugars without the need to prepare the sample or have any physical contact with the samples [2]. The broad spectral output and high optical powers of our tuneable laser system are key to the success of this technique. There are many applications in the pharmaceutical and environmental sectors where this technique will have an important impact.

More recently we have demonstrated the ability to take these FTIR (Fourier Transformed Infrared) measurements through specialist mid-IR optical fibres thus decoupling the measurement tool from the site of the sample [3]. We can already envision how this type of functionality could be exploited across a number of sector specific applications, particularly in environmental applications, be it: making multiple measurements across a particular manufacturing process or characterising the combustion process within a hostile environment such as an industrial chimney stack or the emissions from landfill sites.

The next generation of our tuneable laser FTIR capabilities will address the growing challenge of the quality of hydrogen production, storage, and distribution.

There are several ways to produce hydrogen. Green hydrogen is produced by electrolysis powered by renewable energy sources and is entirely CO_2-free. Blue hydrogen uses the method of reforming natural gas while capturing the resulting CO_2 emissions before they are released into the atmosphere. As part of this process, it is critical to monitor the contaminants within the production process.

Chromacity are now working with a major petrochemical company to develop their FTIR techniques as part of this important environmental requirement.

It is our hope that the ongoing developments of our technology will help Chromacity play their part towards a cleaner Earth and a brighter outlook.

References:

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