

Shown here is Cascade's probe. The device has been developed to improve measurement integrity. It is part of Cascade's multigas real-time analyzer.

## Cascade Fights Emissions Battle

### Laser technology designed to monitor gas emissions

One company at the forefront of tackling industrial emissions in both power and marine industries is Cascade Technologies based in Stirling, Scotland — a spin-off from research work carried out at nearby Strathclyde University.

Cascade offers a detection system for individual or multiple gases from multiple points using one instrument. It said the technology serves a variety of markets, but is especially useful at power stations and in marine environments where there have been stringent new limits set governing emissions from ship exhausts.

The company uses what it describes as “revolutionary patented core technology” based around the application of mid-infrared Quantum Cascade Lasers (QCL), which were invented at Bell Labs, in New Jersey, U.S.A., in the 1990s. Using this technology in a gas-sensing setup allows for the detection of multiple gases simultaneously by producing a chemical “fingerprint” to identify the substance.

Cascade said the QCL is based on a “fundamentally different principle” to normal semiconductor lasers. It said the system operates like an electronic waterfall where electrons cascade down a series of identical energy steps built into the semiconductor material during fabrication, emitting a photon at each step.

This, Cascade claimed, is unlike diode lasers, which it said emit only one photon over the similar cycle and means that QCLs can outperform diode lasers operating at the same wavelength by factors greater than 1000 in terms of power due to the cascading effect and the ability to carry large currents.

Measuring gases in the mid-infrared (IR) region, which QCL does, offers advantages over optical gas sensing in other spectral ranges or other incumbent technologies, according to Cascade.

It claimed that in practice most gases leave their strongest and “unambiguous”

spectral signature in the mid-IR region over a wavelength range (3 to 20  $\mu\text{m}$ ) which is able to be reached with tunable QCLs.

The company, formed in 2003, believes that the QCL offers a range of advantages for detecting gas, including sensitivity. By measuring in the mid-IR range, this offers the ability to accurately measure trace gas concentrations of less than one part per billion. Cascade also claimed that the risk of cross interference from contaminant species is minimal due to the very narrow band at which measurements are recorded.

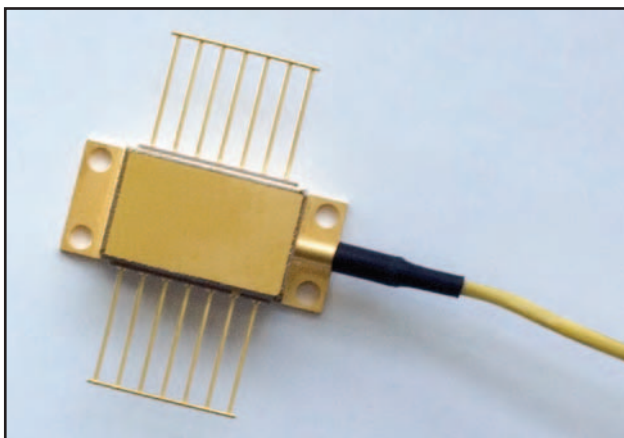
Cascade reported that the technology can achieve thousands of measurements per second with the added benefit that infrared is a nondestructive technique. The technology, which can track multiple gases from various measurement points via one instrument, is currently being tested at a U.K.-based power plant with results expected later this year.

The potential commercial success of the technology was also recently highlighted when Cascade won a technology licensing deal with BP worth more than US\$7.8 million over the next three years. Under the deal, Cascade will design and supply emissions monitoring systems for use in the marine industry through BP exclusively.

According to Cascade, BP Marine has invested in the Scottish company for access to the QCL system with the former providing onboard technical support to approve the laser-based analyzer system.

Krystallon — a joint venture between BP Marine and Kittiwake established to develop pollution abatement methodologies — will supply the scrubbing technology and develop the data recording and data transmission systems.

“We are excited at the prospect of working alongside BP to develop this new application for our ground-breaking technology, which will allow BP to measure emissions more quickly, accurately and cost-effectively,” said Richard



**A packaged Quantum Cascade Laser (QCL) with fiber optics.**

Cooper, business development director of Cascade Technologies. “Cascade Technologies developed and patented the world’s first real-time technology for the detection of emissions, as well as gas and explosives compounds, through its revolutionary use of QCLs. This technology offers unprecedented levels of sensitivity and the ability to quickly analyze complex gases in harsh industrial environments.”

Cascade added that the BP deal was struck in response to the introduction of sulphur emission control areas (SECAs), which set limits on sulphur oxide emissions from ship exhausts. Furthermore, recent maritime legislation (MARPOL) limits the emissions of oxides of nitrogen ( $\text{NO}_x$ ) from ship engines, as well as deliberate emissions of ozone-depleting substances.

Globally, the tendency to further control and tax polluting industries is on the increase, shown by the recent introduction of regulation in Norway to tax emissions of  $\text{NO}_x$  from ships, power stations and utilities.

Using feedback from emission data to the control systems also gives the capability to manage ongoing performance of the engine/boilers/furnaces.

BP Marine said it believed that the new technology will help the shipping industry demonstrate compliance with regulations governing the emissions of nitrogen oxides ( $\text{NO}_x$ ), sulphur oxides ( $\text{SO}_x$ ) and future more stringent import requirements of the European Union.

Today all ships must carry an International Air Pollution Prevention certificate, (IAPP), which certifies that the ship is in compliance with the International Maritime Organisation’s requirements, while from Jan. 1, 2010, the European Union requires that all marine fuel used in EU ports must have a sulphur content of less than 0.1%.

Don Gregory, director, Sustainability and Fuels Technology at BP Marine said that the contract underlined, “the company’s commitment to a sustainable environmental approach for its customers to manage emissions from ships. The first step in managing emissions is to be able to measure emissions. Cascade’s technology enables practical and reliable continuous emissions monitoring of marine diesel engines and boilers to be achieved.”