Timed to perfection

Tiger Optic's CEO Lisa Bergson tells Helen Carmichael that the timing couldn't be better for the company's extremely accurate analyzers to take current and emerging markets by storm.

The recent Semicon West trade show in San Francisco saw Tiger Optics launch its new ALOHA™ ammonia analyzer specifically targeting high brightness light-emitting diode (HB LED) manufacturers. *SGR* was there to catch up with Tiger Optics' founder and chief executive Lisa Bergson, and to learn more about this growing instrumentation company and its products.

Tiger, a leading manufacturer of laser-based trace gas analyzers, already sells devices to HB-LED makers, tool manufacturers and ammonia suppliers. Ammonia is used as a nitrogen source to produce gallium nitride (GaN) compound semiconductor wafers, a core component of HB LEDs. The launch is well timed due to a current surge in demand for HB LEDs, which are used in appliances from cell phones to Apple iPads, as well as liquid crystal display (LCD) television and computer screens *(see full article on Semicon West, p40)*. Measurement of very low levels of moisture in ammonia are critical to developing ever-brighter LEDs. Tiger Optics – which boasts measurements in the parts per trillion range with some of its analyzers – says it surpassed its own sales goals for HB LEDs in the first half by 250 per cent.

The ALOHA™ is the latest addition to a growing range of analyzers from the Warrington, PA based company, which is a spin off from parent company MEECO, Inc. Bergson told *SGR* how the company started out in 1993, when one of MEECO's scientists returned from a conference at the National Institute of Standards and Technology (NIST) saying he had just seen a technology that was going to replace everything the company did. "So naturally I was interested," Bergson says.

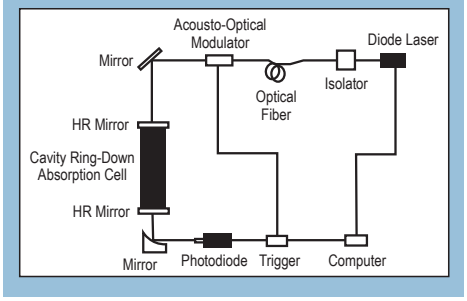
The technology in question – known as Continuous Wave Cavity Ring-Down Spectroscopy (CW CRDS) – was the creation of Professor Kevin Lehmann, then based at Princeton University. Although he defined himself as an "esoteric spectroscopist by training," he also wanted to do "something practical". A fan of smaller companies, Lehmann opted to take the technology forward with Tiger Optics. The company decided to take CW CRDS to commercialization.

What is cavity ring-down spectroscopy (CRDS)?

A form of laser absorption spectrometry, CRDS uses a laser pulse trapped in a highly reflective cavity, where it bounces back and forth between two mirrors. The intensity of the laser pulse resonating in the cavity is known, as is the rate of exponential decay of light in the cavity when the laser is switched off. A gas sample introduced to the cavity will absorb some of the light, leading to faster attenuation of the light beam. The measurement is based on the decay (or 'ring-down') time of the light, which in turn is used to calculate the concentration of gas molecules in the cavity. Also known as cavity ring-down laser absorption spectroscopy (CRLAS), scientists have used the technique to determine concentrations down to the parts per trillion level.

Major advantages of the technique are that ring-down time does not depend on the intensity of the laser, and that the very long path length due to the beam bouncing back and forth repeatedly means that the light effectively travels through thousands of metres of sample in many round trips, offering extremely high measurement sensitivity.

CRDS SCHEMATIC



In the 1990s, Bergson explains, CRDS instruments were rare, bulky and expensive because these employed pulsed lasers. "What Lehmann determined was that you could use a small continuous wave laser the size of a contact lens, and not only achieve ring-downs but achieve better controlled ring-downs," she says. These lasers, a product of the telecom

© Tiger Optics
Lisa Bergson shows off the new MEECO M-i analyzer.

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industry, were inexpensive and widely available.

"We call this 21st century spectroscopy for a reason," Bergson explains. "These techniques have only been introduced in the 21st century. They are based on components and configurations of components that simply weren't available 20-25 years ago." For many applications users find the benefits of this technology – cleanliness, the fact that there are no consumables, response speed, accuracy, and wide dynamic range – overwhelmingly attractive. Components continue to improve and come down in price, which leads Bergson to believe this is just the beginning for the technique.

"Our mirrors are so highly reflective that we actually achieve ~30km within our path length," Bergson says. This is hugely sensitive – about a thousand times more sensitive than the typical spectrometer you would use in college. But Tiger Optics is looking for even more reflective mirror substrates to further hone its spectrometers. Another innovation claimed by Tiger Optics is its laser lock cell, which ensures the laser in the device is always on its peak during measurement.

Tiger Optics analyzers are in use in 13 different national metrology institutes around the world, where they have been put to use developing gas cylinders used to calibrate other people's instruments. In addition to this small but select niche market in institutes, other customers work in areas such as thin films, fiber optics and purifiers. Tiger Optics works with "all the top semi fabs around the world," says Bergson, adding that the analyzers are used not just for moisture but also for oxygen and methane detection, finding their way into quality control, research, bulk gas monitoring, and semi tools applications.

Gases and chemicals remain the heart of Tiger Optics' business, and for those making corrosive or toxic gases, the CRDS has the advantage of being a non-contact technology.

Tiger's CRDS-based analyzers currently work in the near infrared (IR). But the company is now researching materials with a view to pushing into the mid-IR range "which will be fantastic," Bergson says. "Our core markets are gases, chemicals, semiconductor, and laboratory-based, but now we are now moving into applications including clean room ambient and environmental monitoring."

Other future directions could include using quantum cascade lasers, if these eventually come down in price. Bergson says that with these it would become possible, theoretically, to measure ppt levels of dozens of components in one cavity. In the meantime Tiger Optics is offering its award-winning new Prismatic that employs Brewster's Angle prisms, combined with 'multiplexing' up to 16 continuous wave lasers to make more simultaneous measurements.

But has the high-tech CRDS eclipsed parent company MEECO's old-school electrochemical analyzers? "Much to my surprise and gratification, MEECO is doing extremely well," says Bergson. "In fact this year our sales are up 100 percent over last year." It seems that with both 20th and 21st century analysis techniques on offer, there really is something for everyone. SGR

Tiger Optics analyzers

ALOHA
An H_2O moisture analyzer targeting HB LED based on CRDS. The analyzer is compact and a single device can measure moisture in ammonia and inert gases.

HALO and HALO+
Still extremely sensitive, this trace gas CRDS-based process analyzer is very compact. It is also about 40 percent lower in price than Tiger Optics' high-end analyzers.

Laser Trace+
These analyzers are available targeting a wide range of gases. Using mirror-based CRDS, these are ideal for measuring one species per cavity.

Prismatic *(main picture p44)*
More than a decade in development, the recently introduced Prismatic is a single analyzer that can measure trace levels of as many as 16 different molecules.

Tiger-i
A continuous cleanroom analyzer designed for ambient molecular contaminants, such as HCl, HF and ammonia.