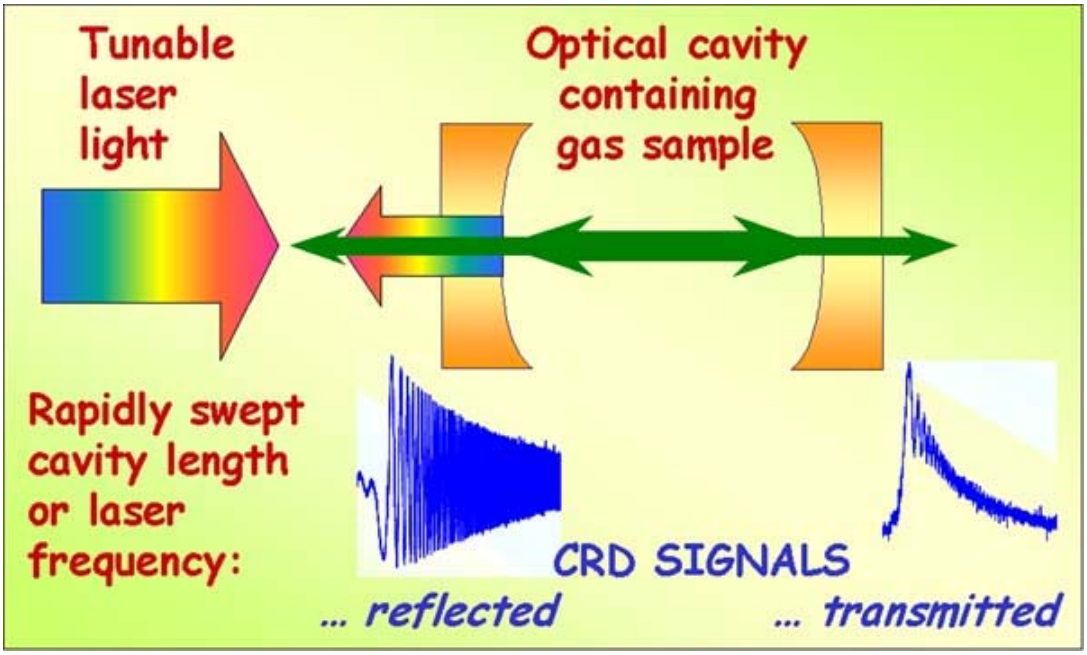
CAVITY RINGDOWN SPECTROSCOPY

Lasers 'sniff' gases in medicine, industry or the environment ...



BACKGROUND

Macquarie University's Centre for Lasers & Applications (CLA) is at the forefront of research on laser-based ways of 'sniffing' gases for diagnostic breath tests, or industrial process control, or screening of molecules at trace levels in air. CLA's 'Sensitive Light' group has developed new forms of cavity ringdown (CRD) spectroscopy for such applications. Laser light tuned to one or more specific optical frequencies is built up in an optical cavity formed by mirrors with very high reflectivity and the composition of gas contained in the cavity is measured *via* the decay ('ringdown') rate of light leaking from the cavity with *either* the cavity length *or* the laser frequency rapidly swept.

BUSINESS OPPORTUNITY

It is a bit like having a laser-based sniffer dog! This is a promising way to perform medical breath tests, enabling non-invasive diagnosis of various diseases - blood, liver, lung, pancreas, stomach, etc. (e.g., $^{13}CO_2$ or NH_3 breath tests for *Helicobacter pylori* associated with peptic ulcers). There are prospects of CRD-based spectroscopic sensing of industrial process gases in or from smelters, furnaces, etc. (e.g., CO/CO_2 ratios to monitor combustion efficiency) or petrochemical plants (e.g., C_2H_2).

The new CLA swept-frequency CRD technique enables rapid, sensitive finger-printing of unknown airborne molecules at trace levels (e.g., for security screening or pollutant identification).

KEY BENEFITS

- Non-invasive technique for diagnostic breath tests
- Applications for atmospheric environmental sensing
- Monitoring process gases to control industrial efficiency
- Simultaneous multi-gas sensing with one or more lasers
- Fingerprint security screening of unknown gas mixtures

MARKET

An innovative feature of the CLA's approach is optical-heterodyne detection, which allows the optical transmitter and receiver to be located in a single module that is linked to one or more CRD cavities by optical fibre.

This leads to powerful analytical chemistry instruments with commercial potential for diagnostic sensing applications in areas such as medicine, agriculture, manufacturing industry, defence, security screening, and environmental monitoring.

The combination of optical-heterodyne CRD detection, a CRD transmitter/receiver unit coupled by optical fibre, and *either* swept-cavity multi-wavelength *or* swept-frequency CRD measurements is particularly advantageous for numerous field-based applications requiring compact, low-cost, versatile spectroscopic sensing of gas mixtures.

TECHNOLOGY

In cavity ringdown (CRD) spectroscopy, tunable coherent light (e.g., from a laser) interacts efficiently with gas-phase molecules in a highly reflective optical cavity. Tuned laser radiation built up in the cavity travels many kilometres.

Weak absorption spectra (at low molecular concentration) are then measurable with high sensitivity and photometric precision. The measured rate at which light leaks ('rings down') out of the cavity can be directly converted to an absorption spectrum. In contrast to CRD spectroscopy with pulsed laser light, the CLA approach uses state-of-the-art miniature continuous-wave tunable diode lasers.

Developmental research on CRD spectroscopy within the CLA has resulted in compact CRD spectrometer designs based on a rapidly-swept optical cavity, miniature tunable diode lasers (including an ultra-compact swept-frequency laser) and other optical telecommunications components.

MANAGEMENT & SCIENTIFIC

Management Team:
Access Macquarie – Mr Warren Bailey

Scientific Team:
CLA – Dr Yabai He & Professor Brian Orr

INVESTMENT OPPORTUNITY

This is a niche market opportunity and Macquarie University is currently seeking a suitable licensee.

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