EPIC Online Technology Meeting
Environmental Monitoring
Monday 15\textsuperscript{th} June

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www.chromacitylasers.com
Our Business

Design and manufacture affordable and compact ultrafast lasers that span the visible to Mid-IR.

**Tunable**
- Fundamental Research
- Raman Spectroscopy
- Pump Source for OPO
- Quantum Optics
- Microscopy (Two Photon, SHG)
- Pump Source for OPO and Non-Linear Optics
- IR Spectroscopy
- LIDAR
- Telecoms
- Quantum Optics

**Fixed**
- Fundamental Research
- Raman Spectroscopy
- Pump Source for OPO
- Quantum Optics

**Mid-IR OPO**
- Fundamental Research
- Spectroscopy (Molecular, Fingerprints and Complex Organic Compounds)

**Near-IR OPO**
- Fundamental Research
- IR Spectroscopy
- LIDAR
- Telecoms
- Quantum Optics

1040 nm
- Fundamental Research
- Microscopy (Two Photon, SHG)
- Pump Source for OPO and Non-Linear Optics

520 nm
- Fundamental Research
- Raman Spectroscopy
- Pump Source for OPO
- Quantum Optics

Dr Kerr Johnson, Chromacity Ltd | EPIC Online Technology Meeting on Environmental Monitoring
The Chromacity OPO is compact, air-cooled and a cost competitive source for IR spectroscopy

- Good beam quality → high resolution, long path length
- High brightness → long path length, high sensitivity
- Broad bandwidth → can probe multiple species simultaneously
- Tunable from 1.4 – 4 µm

These points make it well suited to remote, stand-off detection of gases relevant to environmental monitoring. e.g. hydrocarbons, CO₂

We also provide bespoke solutions for the 5-12 µm wavelength range utilizing other non-linear crystals
Remote hydrocarbon detection

- Simple solution: OPO coupled into Michelson interferometer before sending to distant target
- Light scattered back is collected by telescope and Fourier transformed to give spectrum, including absorption features from gases present in light path
- Demonstrated for simultaneous methane and ethane quantification, but applicable to all molecules with absorptions in wavelength range e.g. CO₂, NO₂
- Shown for range of 70m with no need for precision retro-reflector target (scattering from rough foil) but applicable to km lengths with retro-reflector
- Methane detection with a precision (Allan deviation) of 40ppb for 5 min averaging

Methane and ethane detection with Chromacity OPO

Kara O., Sweeney F., Rutkauskas M., Farrell C., Leburn C.G., Reid D.T. "Open-path multi-species remote sensing with a broadband optical parametric oscillator", Optics Express, 27, 21358-21366 (2019)
Fiber delivered multi-species spectroscopy

- Can also fiber deliver the OPO light to environments which are inaccessible or hazardous e.g. reaction vessels, pipelines, exhaust flues
- Chromacity OPO coupled into Michelson interferometer before launching into fiber
- Output of fiber enters environment of interest (here a gas cell) and detector at distal end of fiber measures spectrum
- Demonstrated quantitative, simultaneous detection of multiple hydrocarbons in a spectroscopically cluttered environment.
- Highlights that the technique can be used for a combination of simple and complex hydrocarbons
Interested in integrating our ultrafast lasers into your solution?
Contact sales@chromacitylasers.com

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