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Mid-Infrared Laser based Trace Gas Sensor Technologies: Recent Advances and Applications

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- Development of robust, compact, highly sensitive & selective mid-IR trace gas sensor technology based on high performance interband cascade and quantum cascade for environmental monitoring,atmospheric chemistry, industrial process control and medical diagnostics
- Development of THz trace gas sensor systems based on QEPAS
- Applications of trace gas sensors development & demonstration of I-QEPAS resulted in a factor of 240 increase in detection sensitivity for nitric oxide (NO) detection
- Future development of trace gas sensors for monitoring of broadband absorbers: acetone(C_3H_6O), propane (C_3H_8), benzene (C_6H_6) & acetone peroxide-TATP ($C_6H_{12}O_4$)

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Laser-Based Absorption Spectroscpy

- **Optimum Molecular Absorbing Transition**
  - Overtone or Combination Bands (NIR)
  - Fundamental Absorption Bands (Mid-IR)
- **Long Optical Pathlength**
  - Multipass Absorption Gas Cell (e.g Astigmatic Herriot - Aerodyne, Aeris Technologies DoE Monitor Bow-Tie)
  - Cavity Enhanced and Cavity Ringdown Spectroscopy
  - Open Path Monitoring (with retro-reflector or back scattering from a topographic target); standoff and remote detection
  - Fiberoptic & Wave-guide Evanescent Wave Spectroscopy
- **Spectroscopic Detection Schemes**
  - Frequency or Wavelength Modulation
  - Balanced Detection
  - Zero-air Subtraction
  - Quartz Enhanced Photoacoustic Spectroscopy (QEPAS)

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Dogs in smell test still beat laser based trace gas technologies in 2018

https://k2canine.com/2017/07/wsj-making-sense-of-a-dogs-olfactory-powers/

Future development of drone mounted I-QEPAS Chemical Sensor Systems

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