Industrial applications of pulsed quantum cascade laser analyzers for trace-gas monitoring

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Wide Range of Gas Sensor Applications
- Chemical Analysis and Industrial Process Control
- Power Generation, Pharmaceutical & Food Industries
- Semiconductor industry
- Oil and Natural Gas Industry
- Urban and Industrial Emission Measurements
- Industrial Plants
- Combustion Sources
- Automobile
- Rare Gas Measurements
- Agriculture
- Environmental Monitoring
- Atmospheric Chemistry
- Volcanic Emissions
- Spacecraft and Planetary Surface Monitoring
- Crew Health Maintenance & Life Support
- Medical Applications

QC Laser Based Gas Sensor Platform

Calibration of Fast Frequency Dialing
- Frequency scaling by means of subharmonic control of a Thermal plasma In its range and the system needs to present
- Due to the limited dynamics of the system the adjustment of a frequency scan is performed incrementally changing approximate potential initial values
- Frequency adjustment to each individual section individually and stepwise during the normal operating conditions of the entire system

DSP Based Pulsed QC Laser Spectrometer

Minimum Number of Points in a QCL Frequency Scan

QC Laser Based QC Laser Sensor Architecture

DSP System Controller Card for Gas Sensor Integration

Molecular Absorption and Laser Sources

Specific issues for Industrial Gas Monitoring with a QC Laser
- High-strength interference emissions
- 850 nm for very particle and gas sources
- Lasing volume interaction
- Overlapping absorption spectra of different species
- Polarization laser output fluctuations
- Laser frequency drift

Temperature distribution in industrial exhaust

Spectral Positions Suitable for Concentration Sampling

OCS Concentration Measurements

Summary
- Two spectrometric sensors (NO and OCS) based on a pulsed TE cooled DFB QC lasers were presented.
- Spectral challenges associated with spectrometric gas analysis of industrial exhaust gases have been identified and addressed.
- Preliminary measurements and calibration of a QC-laser based gas sensors were demonstrated.
- A concept of rapid wavelength scanning using precise wavelength dialing of a pulsed DFB QC laser was implemented.
- A DSP based data acquisition and control system for fast data acquisition and automated gas sensor control is currently under test.