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Field-deployable laser-absorption-based sensor systems for sensitive, calibration-free, *in-situ* gas monitoring with infrared laser sources

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Laser absorption spectroscopy is a unique method to realize direct, non-intrusive, path-integrated measurements of different media conditions. The emergence of robust, non-cryogenically-cooled mid-infrared laser sources, e.g., quantum-cascade lasers and interband-cascade lasers, provide access to the wavelength region where stronger ro-vibrational bands are present for many important species in combustion and environmental monitoring. The present presentation and associated papers review some of the recent advancements in utilizing quantum-cascade lasers and other infrared laser sources to realize real-time, in-situ, calibration-free gas detection in practical, harsh environments. By extending the technology to longer wavelengths, substantial improvements in sensitivity could be achieved. Wavelength-modulation-spectroscopy schemes have been applied and tailored, with optimized parameters to compensate for the relatively lower performance and complexity of the novel types of lasers. Laser characterization schemes and data processing models have been generalized to reduce the need and difficulty for on-site calibration, and improve accuracy despite of the large variation of conditions in practical environments, including temperature, pressure, particulate-loading, and gas composition. The developed sensor systems have been deployed in real-world combustion environments, such as coal-fired power plants and coal gasifiers where fast response, low detectivity and long-term practicality were demonstrated. Furthermore, the laser-absorption based sensors at longer wavelengths have been proved to have better immunity to beam steering noises and fluctuations, which are especially advantageous for unattended monitoring in high-velocity particulate-laden flue gases. With smart opto-mechanical designs and intelligent signal multiplexing schemes, simultaneous multi-species monitoring with minimum operator intervention and cross-interference could also be achieved.

Biography

Xing Chao has completed her PhD from Department of Mechanical Engineering, Stanford University, and she is the Chief Scientist of Oxigraf, Inc., a leading company and manufacturer of laser-based gas sensors in the heart of the Silicon Valley. She also holds Bachelor and Master's degree from Tsinghua University, China, and an Engineering Diploma from Ecole Centrale de Paris, France. Her area of expertise has been focused on laser spectroscopy, with particular application in combustion diagnostics and energy systems. She has published over 10 indexed journal papers, and presented at a number of international conferences of high repute.

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