Concentration-independent pressure sensing method developed for high-temperature combustion diagnostics

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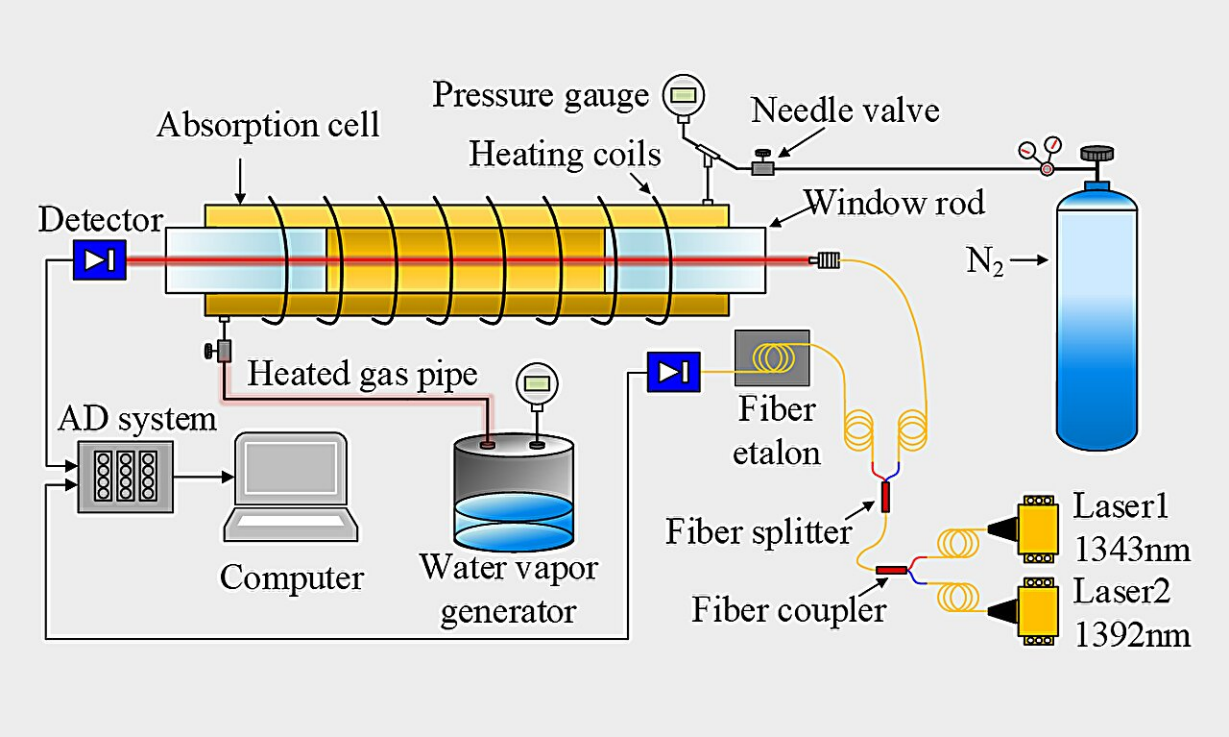

Concentration-Independent Pressure Sensing Method Developed for High-Temperature Combustion Diagnostics. Credit: Wang Ruifeng

Recently, a research group led by Prof. Gao Xiaoming and Prof. Liu Kun from Hefei Institutes of Physical Science (HFIPS), Chinese

Academy of Sciences (CAS), developed a concentration-independent pressure sensing method based on two-color laser absorption spectroscopy for high-temperature combustion diagnostics.

The research results were published in *Optics Letters*.

Aero engines are moving towards high-temperature and high-pressure combustion to improve thermodynamic efficiency. Pressure is an important parameter to monitor engine performance and diagnose engine faults. However, conventional contact pressure sensors not only disturb the combustion flows but also suffer from the temperature tolerance limit of sensor materials.

In this study, researchers developed a non-contact pressure sensing method for high-temperature environments and demonstrated it at temperatures up to 1300 K. This research focused on how to address the effect of molecular concentration on gas pressure measurements in high-temperature environments.

Scientists found that coupling the collision-broadened line widths of two absorption lines could eliminate the concentration variable. With this finding, scientists can realize concentration-independent pressure measurement. Considering the main product of the hydrocarbon-fueled combustion system is H_2O, they validated this finding with two absorption lines of H_2O near 1343 nm and 1392 nm on a carefully designed heated absorption cell. The temporal resolution and uncertainties of the pressure measurements were achieved at 50 μs and 3%, respectively.

"Our finding provided a valuable tool for pressure sensing in high-temperature environments and can promote the development of laser-based multi-parameters diagnostics for combustion science," said Prof. Liu Kun.

More information: Ruifeng Wang et al, Pressure sensing with two-color laser absorption spectroscopy for combustion diagnostics, *Optics Letters* (2024). DOI: 10.1364/OL.506204

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