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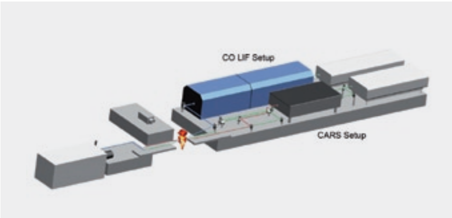
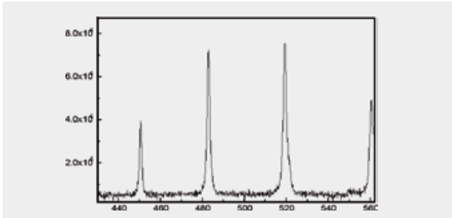
CO Concentration at Near Wall Conditions Using Two Photon Laser Induced Spectroscopy



Experimental Setup



Two-Photon LIF Spectrum of CO

Motivation

The aim of the project is to measure the concentrations of carbon monoxide (CO) in a flame and detect the variation in the concentration in the presence of a wall like structure in the flame. The quantitative measurement of combustion intermediates present at minute concentrations is of paramount importance, as the correct prediction of the concentrations of radical intermediate species in a flame is a stringent test of combustion models. CO is an important molecule in combustion industry as it serves as an indicator of combustion efficiency and also because of its greenhouse properties.
Temperature is a crucial parameter in the quantitative laser-induced fluorescence experiments. The concentrations of various species in the flame are temperature-dependent as the quenching coefficients of different species vary as a function of temperature.

Method and Theory

Laser-induced fluorescence (LIF) is uniquely suited to probing chemical intermediates in combustion environments as the technique is non-intrusive, extremely sensitive, highly selective and offers excellent temporal and spatial resolution. For many of the combustion species, like CO, the excitation energies lie in VUV region (<180 nm). Atmospheric gases being opaque to radiation below 180 nm, a vacuum condition becomes a necessity for a one-photon LIF measurement, therefore two-photon LIF is an important technique in the determination of these flame species.
Quenching refers to any process which decreases the fluorescence intensity of a given substance. Collisional quenching involves collisions with other molecules resulting in the loss of excitation energy as heat instead of as emitted light. The quenching coefficients of CO by various species have to be considered during the quantitative estimation of its concentration.

Proceeding

For the standardization of the procedure, a premixed flat flame burner was used as a source of CO. The advantage of using the burner is that the concentrations of flame species can be accurately calculated. The measurements were carried initially using a spectrometer and a camera. The wavelength dispersed spectrum obtained confirms that the CO two-photon LIF signal is indeed being measured. A water cooled-wall would be introduced in the flame and CO concentration would be measured close to the wall in order to determine the effect of wall on the CO concentrations.