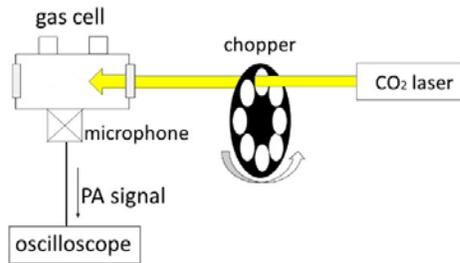


Photoacoustic Spectroscopy with an Optically Thick Greenhouse Gas

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Photoacoustics is the generation of acoustic waves by modulated optical radiation. Alexander Graham Bell accidentally found the photoacoustic effect in 1880. Photoacoustic spectroscopy records the heat release via pressure changes, following the conversion of absorbed energy into heat. photoacoustic spectroscopy does not measure transmitted light intensities, sample opacity and scattering difficulties do not limit this analytical method. Photoacoustics can be used to determine different thermophysical and acoustic properties of a system, such as density, sound velocity, thermal diffusivity, and viscosity.



Photoacoustic spectroscopy will be used to test the photoacoustic properties of an optically thick and potent greenhouse gas. Detection of trace amounts of the gas is also implemented. The conditions in which the gas is tested, gas cell length, temperature, concentration, and power of the laser, will be varied in order to determine their effect on the photoacoustic signal, and an ideal condition to detect trace gas amounts. A detection limit will be determined for greenhouse gas.

Figure displays a diagram of the experimental set up with a CO₂ laser. The light emitted from the laser is aligned and directed towards a gas cell. A microphone is placed inside the gas cell. A He-Ne laser is used as a reference laser and is detected by a photo detector. The photo detector and microphone are connected to a digital oscilloscope. An optical chopper is placed in front of each laser in order to pulse the continuous lasers. For experiments conducted involving temperature, a heating pad, connected to a temperature controller, is placed inside the gas cell to heat the cavity.

The student will learn how to build up experimental setup with optics, operate lasers and analyze data. The student will also be encouraged to present their work at the 68th Southeastern Regional Meeting of the American Chemical Society (SERMACS) held in Columbia, SC in 2016.