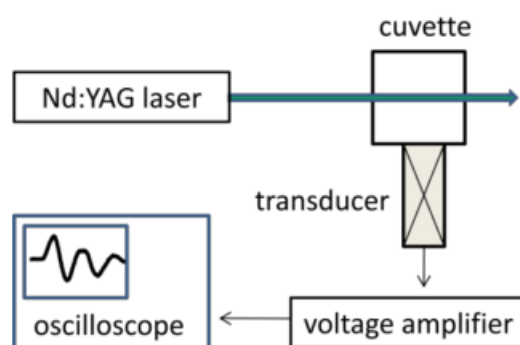


Experimental Physical Chemistry Research on Photoacoustics

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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.



Suspension of small carbon particles in fluids can have sufficiently large optical absorption cross sections that upon irradiation of the suspension with a high power pulsed laser, the surfaces of the particles can be driven to sufficiently high temperatures so as to initiate chemical reactions at the particle-fluid interface. This leads to the formation of permanent gas above the suspension. Equation below shows a linear relationship between acoustic pressure and laser energy.

$$\frac{p_0}{E_0} = \text{const} \frac{\beta v_a}{c_p} \alpha$$

where p_0 is the acoustic pressure amplitude developed, E_0 is the laser energy in a pulse or in a cycle, β is the thermal expansion coefficient, c_p is the specific heat at constant pressure, v_a is the acoustic velocity, and α is the optical absorption coefficient of the medium.

We will examine thermal expansion of the fluid as heat diffuses from optically heated particles at the various conditions.

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 67th Southeastern Regional Meeting of the American Chemical Society (SERMACS) held in Memphis, TN in 2015.