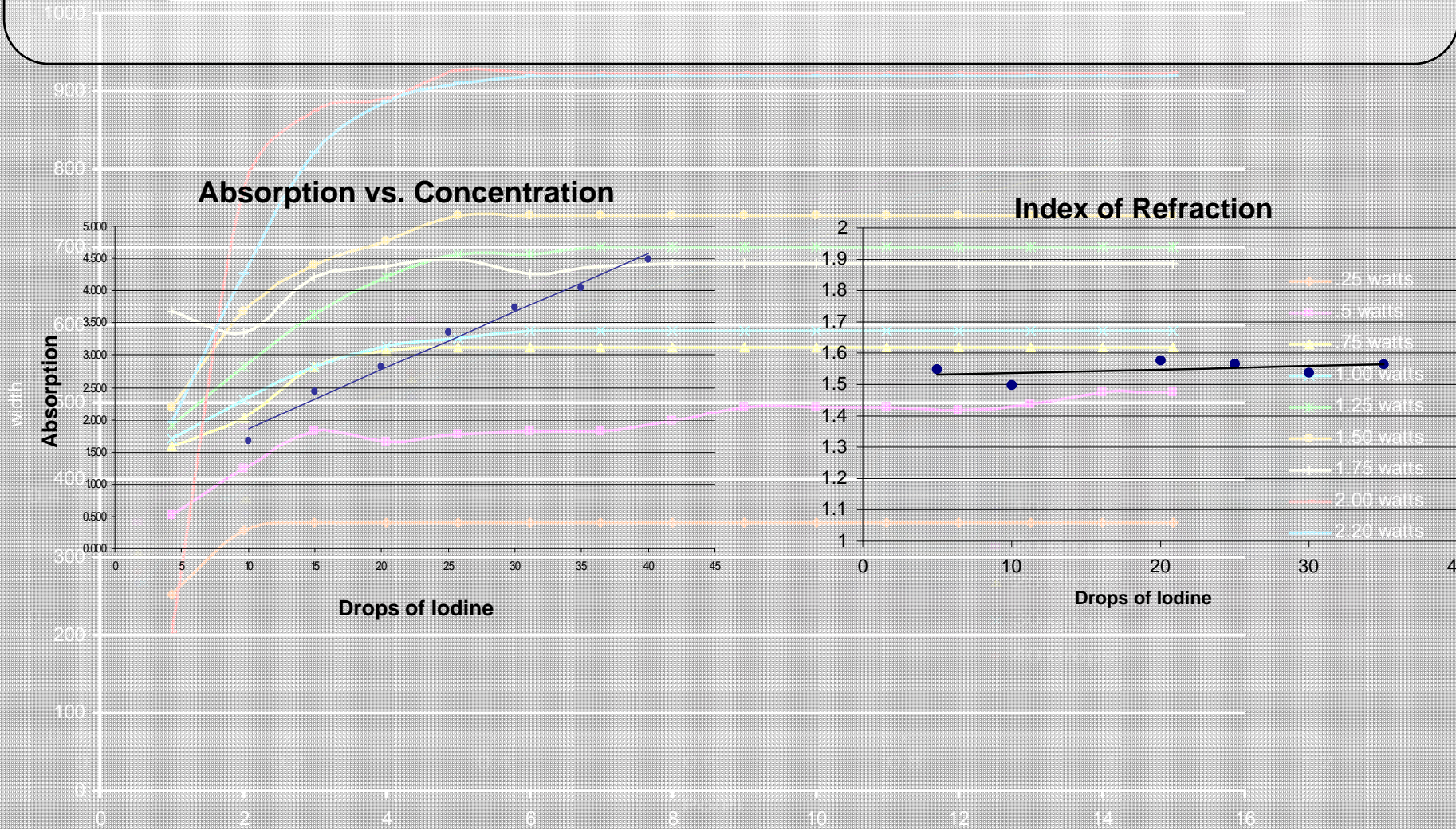


Liquid Characterization Using Visible Light Lasers

Colette M. Szabo-Long, Jacob D. Gayles, Can Sun, Jason W. Fleischer
Department of Electrical Engineering, Princeton, NJ 08544, U.S.A.

Response Time

Absorption and Index of Refraction





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LASER

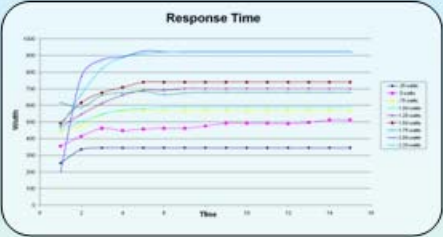
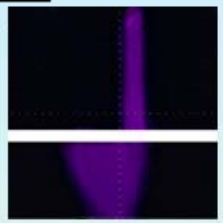
Introduction:

- The motivation for this study was to provide information on a nonlinear liquid to be used in future experiments.
- In this study, a green, 532 nm, visible light laser was used to measure the nonlinear propagation of a thermal liquid.
- The liquid characterized was a solution of iodine and ethyl alcohol where the iodine worked to absorb the green light and the ethyl alcohol allowed the light to travel quickly.
- The liquid was a Gaussian beam.

GAUSSIAN BEAM

Response Time:

- As the Gaussian beam travels through space the light diverges. Over time, the beam diverges more and more and spreads a noticeable amount.
- The beam in this experiment was filtered through a mirror to make it linear. The camera recorded the expansion of the beam over time.
- The first and last frames captured by the camera were measured and plotted against time to find the response time, or how long it took for the beam to diverge completely.
- The figure to the right shows the beam as it first appears (top) and after it has completely diverged (bottom).



Nonlinear Diffraction:

- Nonlinear diffraction occurs when the plane wave beam is nonlinear.
- The light focuses in toward the lower index area and more area of light "converges" and shock, the plane wave.

BEAM SPLITTER

LENS



Absorption:

Absorption is the process by which the energy of the incident light is converted into other forms of energy, such as heat or chemical energy.

The equation for absorption is:

$$I = I_0 e^{-\alpha L}$$

Where I is the intensity of the light after passing through a medium of thickness L , I_0 is the initial intensity, and α is the absorption coefficient.



Refraction:

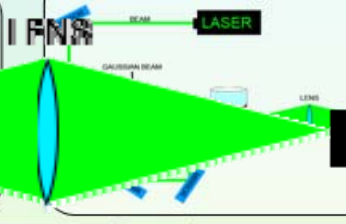
Refraction is the bending of light as it passes from one medium to another with a different refractive index.

The equation for refraction is:

$$\frac{\sin \theta_1}{v_1} = \frac{\sin \theta_2}{v_2}$$

Where θ_1 and θ_2 are the angles of incidence and refraction, and v_1 and v_2 are the speeds of light in the two media.

Setup

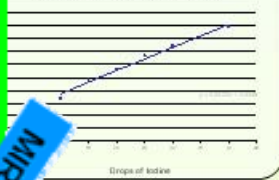


CCD CAMERA

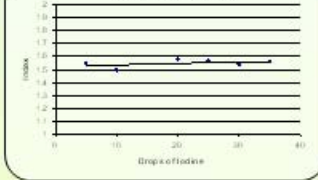
Shock wave Width vs. Intensity of



Absorption vs. Concentration



Index of Refraction



Conclusions:

- The absorption of the liquid is directly proportional to the concentration of iodine.
- The index of refraction stayed nearly constant at all concentrations and is about 1.33.
- The curves of the shockwave width vs. intensity grow at faster rates for higher concentrations of iodine.
- The response time of the liquid was faster for higher intensities of light.

MIRROR

MIRROR

MIRROR

