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# Sample Preparation of sol-gel Material

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## Introduction

Rhodamine-B (Rh-B), the best known of all laser dyes, is Xanthene derivative and is ionic with an absorption peak at ~ 543 nm and a fluorescence peak at ~566 nm as shown in figure 1 and 2.

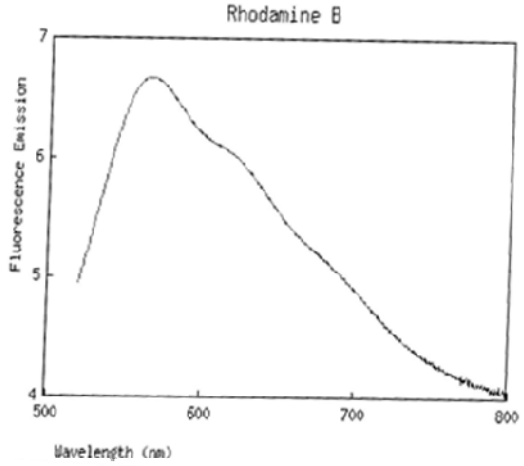


**Figure 1:** Absorption spectra of Rhodamine – B in methanol.

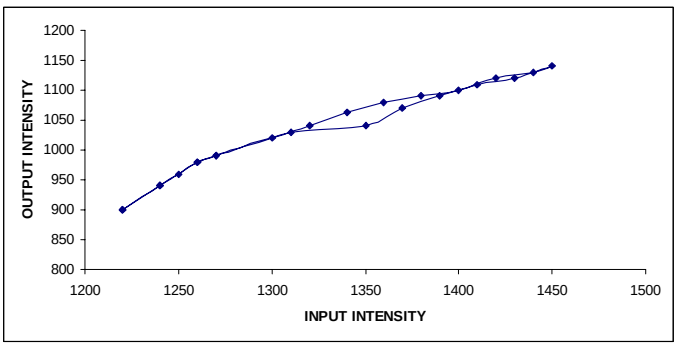


**Figure 2:** Fluorescence Spectra of Rhodamine-B in methanol.

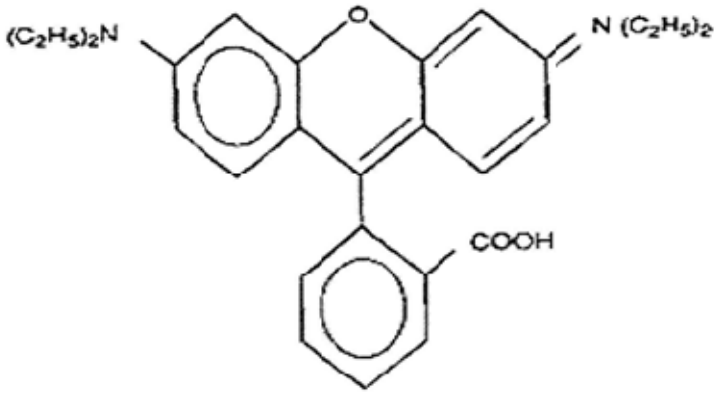


**Figure 3:** Molecular structure of Rhodamine –B.

Rh-B dye samples of various concentrations ranging from ~ 0.1 mM to ~ 1 mM are entrapped in Tetra-ethyl-ortho-silicate ($Si(OC_2\ H_5)_4$) [TEOS] by using Sol-Gel Technique. During the process, 5 ml of TEOS and dye concentration dissolved in ethyl alcohol are added and then add dropwise 3 ml water with acidic environment. The chemicals are taken in the following proportion:

$$[TEOS + (Et\ OH + Dye) : [H_2O + HCl\ ] : 10:03$$

The solution is kept under vigorous stirring at room temperature about 3-4 hours to yield clear and stable sol and then to get in gelation form. This is put in a glass cuvettes for a week for drying and the glassy matrices are formed as the blank sample.

During densification, the porous gel structure sinters and shrinks to approximately 50% of its original size, yielding a densified sol-gel glass with smaller pores and thicker pore walls. Similarly other samples of concentration ranging from 0.1 mM to 1.0 mM are prepared.

It is worth mentioning that the environment inside a pore has some chemical similarity to the environment offered by ethanol. The surface of pores consists of silanol groups (Si-OH) and is highly polar in nature. The silanol groups are available sites for hydrogen bonding with other species that may include dye molecules or water, inside the pore network[36-37].

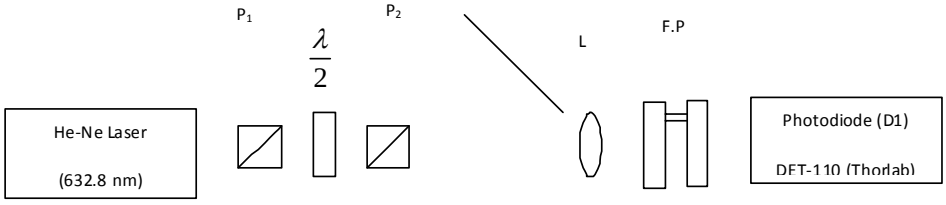


**Figure 4:** Experimental Set-up.

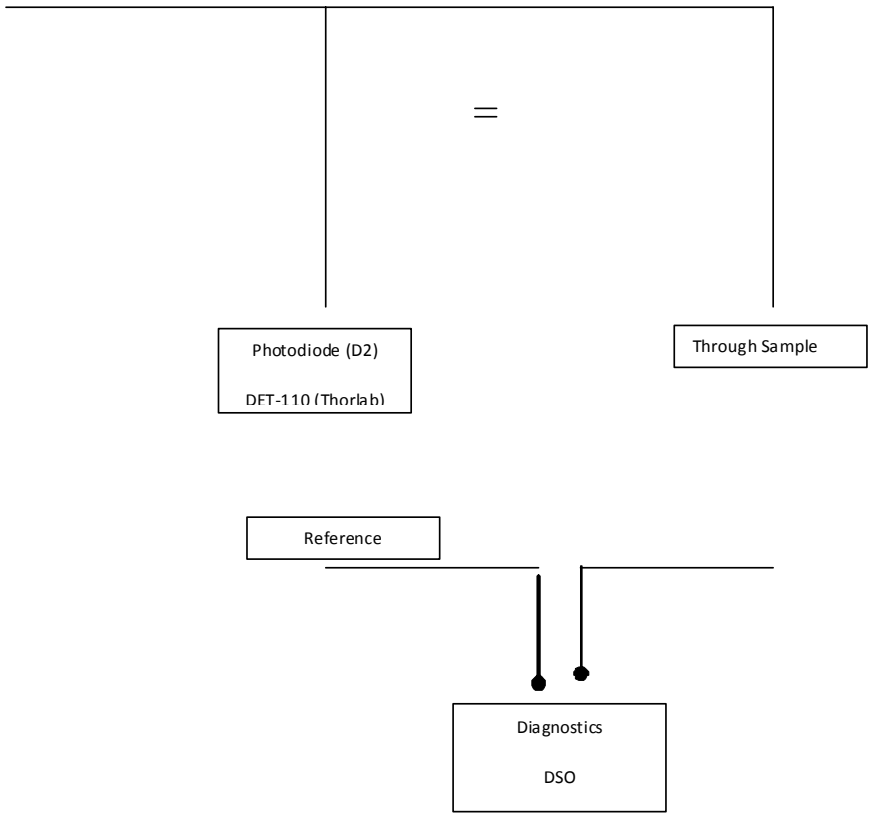


**Figure 5:** Block Diagram for the study of optical bistability.

Fig 5 shows a set-up for the demonstration of optical bistability using a dye filled etalon. He-Ne Laser : light source; $P_1$ and $P_2$ : two polarizing cubes; $\frac{\lambda}{2}$: half wave plate; L : Lens; F.P: Fabry-Perot etalon (Optical Bistable Device); $D_1$ and $D_2$ : two silicon photodiodes; Digital storage Oscilloscope.

A He-Ne laser operating at 632.8 nm with an unpolarized output power of ~ 25 m W is employed as the light source. The He-Ne wavelength allows the pumping of Rhodamine-B dye molecules. The light intensity is varied by modulator consisting of two polarizing cubes, $P_1$ and $P_2$ and a half wave plate, delivering a maximum laser power at the etalon. Fabry- perot etalon is filled with a nonlinear dye solution to form an optical bistable device. A lens L is used to focus the laser beam on to the dye medium. Two silicon photo cells, $D_1$ and $D_2$ are positioned to detect the incident light and output light power. The output from $D_1$, which monitors the intensity $I_0$ , is connected to the Oscilloscope[38].