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TUNING OF DYE LASERS BY THE USE OF CHRISTIANSEN FILTERS*

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Organic dye lasers are sources of stimulated light tunable within a wide range of wavelenghts. A method of tuning was first proposed by Sofer and McFarland[1)] in which one of the laser mirrors in the cavity was replaced by a diffraction grating. This grating was mounted in a Lithrow arrangement with an angular adjustment enabling the first order reflection of desired wavelength to be reflected back along the axis of the optical cavity. By rotation of the diffraction grating the wavelength of the peak emission could be selected. Bradley et al. described another method of tuning. In their version one mirror was replaced by an Echelle grating and in addition a Fabry--Perot system was placed within the cavity. Tuning, within the spectral range of the Fabry-Perot etalon, was performed by its rotation. In this mode a tuning range of over 50 nm of the dye laser emission with a line width of 0.5 Å could be obtained.

This paper deals with a simple method od dye laser tuning by a Christiansen filter inserted in the cavity. The simplest form of a Christiansen filter can be obtained by immersion of a glass plate in a liquid that has, for the desired wavelength, the same index of refraction. It can be easily shown, as was done in our experiment, that for the particular wavelength for which the liquid and the glass have the same refractive properties, the whole filter acts as a homogenius medium and rays of this wavelength are transmitted without deviation or refraction loses within the filter and laser cavity. Rays of shorter or longer wavelengths are deviated and reflected by amounts corresponding to the differences of indices of refraction at the boundaries between glas and liquid.

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An experimental arrangement of a Christiansen filter in a dye laser is shown in Fig. 1. In this case the Christiansen filter was formed by a crown glass prism immersed in a mixture of carbon disulfide and benzene. Variing

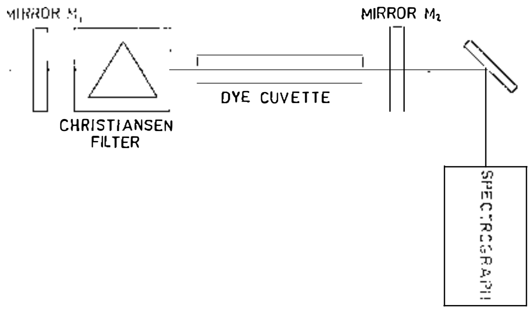

Fig. 1. Schematic diagram of aparatus.

the concentration of CS_2 in C_6H_6 between 5% and 15% (volume) it was possible to change the index of refraction of the solution so that the filter was transparent for light rays between 5800 Å and 6100 Å tuning thus the laser for the particular wavelength. For example, when the content of CS_2 in C_6H_6 is 1 : 10 the transparency lied at 5890 Å and the peak laser emission had this wavelenght.

The efficiency of a Christiansen filter mounted in the laser cavity is multiplied since the stimulated light oscilates within it and in each passage throught the filter rays of unwanted lenghts are more and more eliminated from the laser action.

For three concentrations (5%, 10% and 15%) the outputs of dye laser spectra were analysed by a spectrograph (Hilger Medium Quartz) and re-

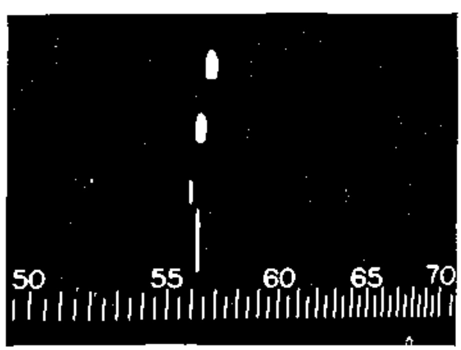

Fig. 2. Emission spectra of tuned dye laser. The line at the bottom is an Na D calibration.

corder on photographic plates (Ilford R-20). The obtained records, shown in Fig. 2, show that tuning with fairly broad emission lines was obtained in the wavelength range between 5800 Å and 6100 Å.

In the experiments to follow, Christiansen filters will be made by immersion of irregular glass particles in corresponding liquid solutions in order to gain in spectral purity of the emitted light. An analogous mode of tuning could be thought of in variing the temperature of the Christiansen filter influencing thus the refractive properties of the media.

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