

FIG. 1. Dual-light source for 17-in. aperture diffused light polariscope.

(green), 5790 Å (yellow). The dominant green line gives a rather clear monochromatic fringe pattern to well above ten orders of interference. A Wratten 77A filter can be used to sharpen up the fringes, but it is not required for general observation.

The use of clear tubes for the monochromatic source allows the placement of a second bank of white tubes (G.E. F-15-T8/CW) behind the first. Each bank is supplied through an individual switch so that they may be illuminated separately or together. This permits the focusing of the polariscope camera on the specimen edge with a relatively high intensity source and then turning off the white light to photograph the specimen fringe pattern in monochromatic light.

Additional construction features of the light housing employed in the 17-in. diffused-light polariscope at Princeton University are shown in Fig. 1. The polariscope has seen much service since its fabrication last year, both as a research instrument and for instruction. The dual-light feature has been particularly convenient for teaching.

It was in conversation with Professor A. J. Durelli and V. J. Parks of Catholic University that the basis of this design was derived. The writer gratefully acknowledges their contribution. Spectral analysis of the clear fluorescent tubes was performed by Dr. J. G. Hirschberg of the Princeton University Plasma Physics Laboratory.

### Spectral Characteristics for a Neodymium Laser Liquid Filter System

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THE study of suitable optical excitation techniques is a basic problem in generating coherent optical radiation from a pulsed or cw solid-state laser device. Most optical pump sources emit over a broad portion of the spectrum<sup>1</sup> rather than over the fairly narrow characteristic absorption bands of a laser material. Hence, only

part of the available power density from optical excitation sources is available for producing population inversion, while the unused pump radiation may induce thermal effects detrimental to laser performance in a potentially active medium. This leads to optical path length changes, increased fluorescence linewidths, and unfavorable relaxation times, all tending to raise laser threshold conditions and resulting in reduced output beam intensity. This kind of situation requires optimizing the pump source or eliminating ineffective radiation. In this note the spectral transmissions of several liquids are described, and an optimum liquid filter for neodymium laser materials is determined.

Since spectrally selective excitation lamps of sufficient power are not available as yet, an indirect approach of appropriate optical filtering will permit the reduction of heat generation to a practical minimum. Furthermore, some neodymium doped host materials are damaged when exposed to ultraviolet radiation. The choice of a filtering medium must be compatible with the selection and design of an efficient and stable cooling and optical system. This is important in order to reduce internal heating caused by radiationless transitions which occur in the laser material. Furthermore, the presence of a coaxial sheath of transparent refractive material will increase the over-all effective pumping efficiency of the active laser core.<sup>2</sup> Hence optimum laser device efficiency can be achieved with a liquid filter system.

The filter requirements for a neodymium laser material can be obtained by inspection of the characteristic absorption data.<sup>3</sup> Several narrow absorption bands exist between 3500 and 9000 Å with the most important pumping band centered at 5800 Å. To realize such a limited band spectrum from broad spectral emitters such as commercially available flash and arc lamps, several liquid filters may be tried.<sup>4-7</sup> Water solutions of copper chloride, copper sulfate, nickel sulfate, potassium permanganate, sodium nitrate, sodium nitrite, and potassium chromate were prepared in varying degrees of concentration. These solutions were found to be photochemically stable when radiated with high intensity xenon or Hg lamps as used for laser pumping. The transmission characteristics of these solutions for a 1-cm optical path in a glass cell were run at room temperature with a Beckman ratio recording spectrometer from 3400–20 000 Å, using a photomultiplier and lead sulfide cell detector to cover this range. The important quantitative data for the various liquid filters investigated are summarized in Table I. Some of the appropriate absorption spectra are shown in Figs. 1 and 2. From these data it is clear that either a weak acidified solution of copper chloride or an aqueous solution of potassium chromate or sodium nitrite provide the optimum transmission characteristics as effective filters for an optically pumped neodymium laser system. For laser host materials susceptible to ultraviolet radiation, the latter two liquid filters are

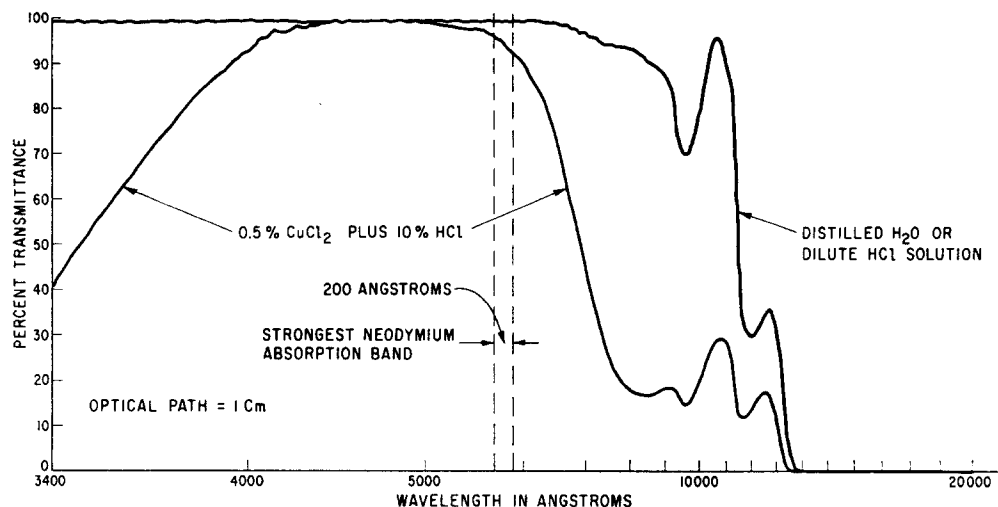


FIG. 1. Optical transmittance vs wavelength of distilled water and dilute copper chloride liquid filter.

TABLE I. Properties of various liquid filters.

Filter and color	Concentration (wt. %)	Half transmission limits (Å)	Optical center of transmission band (Å)	Maximum transmission (1-cm cell)	Transmission at 5800 Å (1-cm cell)	Longer cutoff wavelength (<10% transmission)
CuCl <sub>2</sub> ·2H <sub>2</sub> O (blue)	1	3700-6400	5500	70%	68%	13 500
	10+10 conc. HCl	4500-5400	5000	90%	40%	6400
	1+10 conc. HCl	3700-6600	4750	98%	90%	7600
	0.5+10 conc. HCl	3450-6900	4600	99%	93%	13 500
K <sub>2</sub> CrO <sub>4</sub> (yellow)	10	4800-11 500	6000	99%	99%	13 500
CuSO <sub>4</sub> ·5H <sub>2</sub> O (blue)	1	5200-11 500	6000	99%	99%	13 500
	5	<3400-6250		99.5%	75%	6750
H <sub>2</sub> O	1	<3400-7000		99.5%	95%	13 500
HCl	100	<2200-11 250		99.5%	99.5%	13 500
NaNO <sub>3</sub> (clear)	10	2200-11 250		99.5%	99.5%	13 500
NaNO <sub>2</sub> (clear)	50	3360-11 250		99.5%	99.5%	13 500
NaNO <sub>2</sub> (clear)	1	3430-11 250		99.5%	99.5%	13 500
NaNO <sub>2</sub> (clear)	10	3950-11 250	6000	99.5%	99.5%	13 500
NiSO <sub>4</sub> ·7H <sub>2</sub> O (green)	5	4100-11 250	6000	99.5%	99.5%	13 500
KMnO <sub>4</sub> (purple)	0.005	7500-9500	9000	85%		
		4250-6400	5200	95%	70%	13 500
		<3400-3650				
KMnO <sub>4</sub> (purple)	0.005	3650-4750	4250	97%		
		5560-11 100	8000	98%	60%	13 500

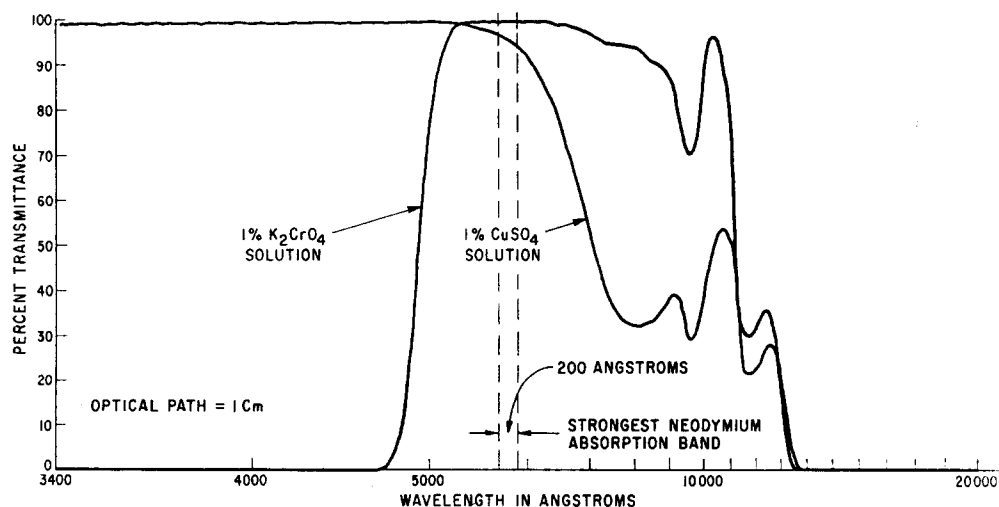


FIG. 2. Optical transmittance vs wavelength of potassium chromate and copper sulfate liquid filter.

more suitable.<sup>7</sup> The assistance of R. Doyle is gratefully acknowledged.

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## Simplified Preparation Method for Carbon Replicas and Carbon Film for Specimen Support in Electron Microscopy\*

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ONE of the main difficulties in the preparation of carbon films by carbon evaporation for specimen support and of carbon replicas of microcrystals is the removal of the carbon film from the supporting base and the transfer of the film onto a grid. In accordance with conventional methods,<sup>1-8</sup> the carbon film either was backed by a plastic coating on one side (Formvar, Bedacryl) in order to provide a mechanical support, or water-soluble detergents were applied to the base prior to the evaporation process,<sup>9-11</sup> which facilitated the floating of the film in a water bath. Both methods, however, were accompanied by certain disadvantages. The plastic coating, which disturbs the inspection of the carbon film in the electron microscope, must be dissolved in an appropriate solvent. If this operation is not carried out with utmost care by repeated application of baths in an increasing concentration of solvents, large portions of the layers may be destroyed by tears. In addition, minute particles of carbon film from the destroyed layer are deposited on the undamaged layer portions. Moreover, an incomplete dissolution of the supporting layer may cause the impression of simulated structures. Detergents applied prior to evaporation may be responsible for an undesirable structure of the carbon film for specimen support. With a collodion layer embedded between glass and carbon, the carbon films indicate an intensive tendency to curl after removal of the collodion. A method for the production of carbon films for specimen support described by Mathews and Buthala<sup>12</sup> avoids the difficulties and sources of error accompanying the above-mentioned methods, but has the disadvantage of a relatively prolonged procedure for floating the carbon layer.

For some time in our laboratory the following method for the preparation of carbon replica (a) and carbon film for specimen support (b) has been used:

(a) The microcrystals to be examined are placed on carefully cleaned glass slides and are subjected to carbon evaporation. Subsequently, the carbon film is scratched into small-sized squares adapted to the size of the grid. A mixture of 0.5–1% HF, approximately 10% CH<sub>3</sub>COCH<sub>3</sub> (acetone), and water is prepared in a flat plastic tray, and the glass slide with the carbon film on top is immersed in a flat angle to the liquid level after removal of the carbon layer on the glass edges by scraping. As a result of the reduction of the surface tension due to the addition of acetone, the weak HF solution creeps between glass surface and carbon layer and dissolves away the top layer of the glass so that the carbon layer is lifted off, together with the enveloped crystals, and floats on the surface. A careful manipulation makes it possible to pick up the entire layer already scratched into squares by lifting the immersed glass slide, and to float it onto another liquid surface. Since, as a result of the low acetone concentration, the surface tensions of both liquids are nearly equal, there is no possibility for the formation of an artifact by mechanical tension. The carbon squares can be picked up in the usual manner either with the aid of round-melted glass rods or by the smooth side of a supporting grid. They are then transferred to the surface of other appropriate liquids for dissolving the crystals and for subsequent washing steps. Finally, they are again collected on supporting grids.

The entire floating and washing process requires less than 5 min. In addition, portions of the preparation where inspection with a light microscope has revealed the crystals to be optimally dispersed can be located approximately and examined with the electron microscope.

(b) Carbon films for specimen support are obtained in the same way, whereby a carbon replica is made from a cleaned glass surface. It proved appropriate to apply, for example, suspensions, colloids, dusts, and aerosols on the carbon layer in form of drops or dust before they are removed from the glass. Since the top surface of the carbon film does not receive any treatment with a liquid during the subsequent preparation, this method is applicable without expecting any additional artifacts. If carbon films for specimen support are to be used for picking up ultrathin sections, the method for an improved adhesion of the films on the shanks of the grid described by Mathews<sup>12</sup> proved its value.

\* Summary of a paper presented at the Conference on Electron Microscopy at Zürich, September 1963.

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