The monitor was calibrated using the buffered KI method.[2] Ozone generated by a GE 04S11 bulb was pulled simultaneously through the monitor and an impinger containing the buffered KI solution. The net current (current measured at a particular concentration minus PMT dark current) is plotted as a function of the measured concentration in Fig. 3. The PMT dark current was 2×10^{-10} A at 1440 V. A 10% error would result from completely ignoring the dark current at a concentration of 10 parts per hundred million. At lower concentrations, errors in subtracting dark current become more serious.

One serious problem with using the monitor around an accelerator is its sensitivity to radiation. A radiation field of 1 mR/h from a radium source will produce a current equivalent to 6 parts per hundred million. This trait can be used to some advantage by using a small source to check instrument operation. If low concentrations are being measured the instrument must be shielded or a sample pulled through tubing from the radiation area.

* Work supported by the U. S. Atomic Energy Commission.

[1] G. W. Nederbragt, A. Van Der Horst, and J. Van Duijn, Nature **206**, 87 (1965).

[2] Air Industrial Hygiene Methods in Air Pollution Measurement SDPH 1-20 (1960).

Reduction of Rayleigh Light by a Wavelength Selective Optical Chopper and an Array of Filters

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THIS note describes the construction of a wavelength selective optical chopper and an array of filters which reduces unwanted scattered light and ghosts in the Raman spectra by $>10^5$. In the study of the Raman effect, the problem of scattered light and ghosts arising from both single and double grating spectrometers often hamper the detection and discrimination of Raman lines.

A new detector method[1] has been developed which can be used with a single or double spectrometer to reduce scattered light by $>10^5$ and eliminate ghosts from the Raman spectra. The new Raman scattering technique, shown schematically in Fig. 1, is highly selective in that the Rayleigh light is first reduced by a filter network. The Raman spectrum is then chopped by a wavelength selective optical chopper and phase detected while the residue Rayleigh light and ghosts are not. The stages of operation and experimental verification of the new scattered light discriminating technique have been described elsewhere.[1]

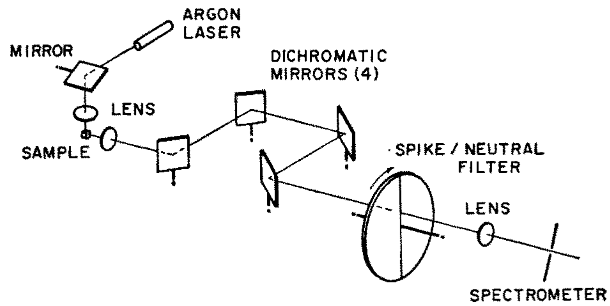

FIG. 1. New Raman scattering system.

Figure 2 shows the construction of the Raman scattering system. It consists of an argon laser, a sample holder assembly, an array of filters, a wavelength selective optical chopper, a $\frac{1}{2}$ meter Jarrell–Ash spectrometer, an RCA 7265 PMT, and a PAR JB-5 lock-in detection system.

The laser light which is filtered by a 5 Å narrow band filter is either reflected by three mirrors and focused vertically onto the sample by a 42 mm diam, 100 mm focal length lens or focused directly by removing the first mirror. The sample is mounted on a goniometer for positioning. Two collecting lenses 25 mm in diameter and of 50 mm focal length are positioned at their focal positions for 0 and 90° Raman scattering experiments. Parallel light is transmitted from one of the lenses to a filter network. The network is an array of four 38 mm square spike filters on adjustable mounts. The filters[2] transmit a bandwidth of 10 Å at 4880 Å for an angle of incidence of 45°. This assembly reduces the Rayleigh line by $\sim10^3$ and the Raman lines by ~3.

The filtered scattered signal is then passed through a rotating filter assembly which consists of two semicircular filter disks (spike–neutral density).[2] The spike filter transmits only a bandwidth of 10 Å at 4880 Å with a transmission of 50%. The 100 mm diam filter assembly is driven by

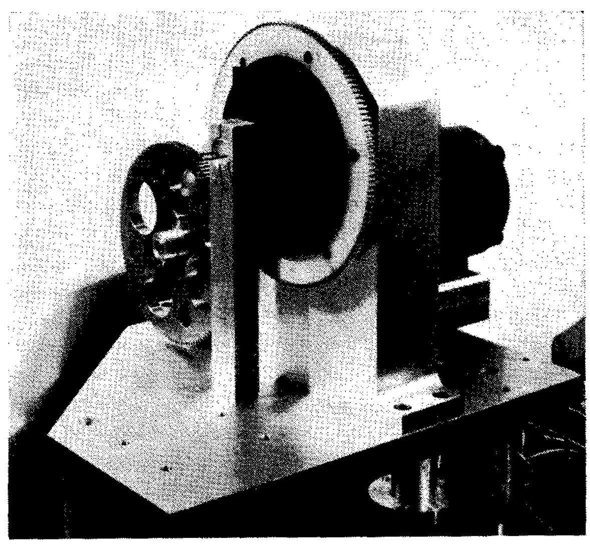

FIG. 2. Photograph of wavelength selective optical chopper.

a 900 rpm Bodine hysteresis motor which is coupled to a drive gear. The torque is transmitted to the filter assembly at a 780/900 reduction (13 Hz). The filters are clamped in a neoprene O-ring cushioned gear adapter plate and mounted in a bearing housing. The filter assembly is placed in such a way that the path of scattered light beam passes through one side of it. As the filter assembly revolves, it chops the Raman light. The chopped Raman light output is focused into an $f/9.8$ spectrometer by a 35 mm diam 270 mm focal length lens. The lock-in which detects the chopped signal discriminates and reduces the Rayleigh and ghosts signal by $\sim$300.[3]

A penlite cell with a Corning 2-64 filter is mounted on one side of the spike–neutral filter opposite a PbS photocell detector. This filter eliminates wavelengths less than 6400 Å and reduces stray light in the critical wavelength region. The photocell output provides a 6 V reference signal for the lock-in. For a horizontal scattered image, a Dove prism may be readily mounted between the collecting lens and the spectrometer to accommodate the image of the scattered light to the vertical spectrometer slit.

[1] R. R. Alfano, Appl. Opt. 8, 2095 (1969).
[2] The filters were obtained from C. Neville of Corion Instruments Co., who matched the spike and neutral density to within 0.3% at the peak wavelength of 4880 Å.
[3] The reduction of Rayleigh line can be $> 10^3$ if the transmission and matching of the spike-to-neutral density is better than 0.1%; hence the total system discrimination could be $> 10^6$.

A Multiple-Sample Low-Temperature Optical Cell*

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IN order to measure the optical absorptivity of solids and liquids the transmission of several samples of different thicknesses must be measured to take account of losses other than absorption. If the several samples can be placed in the beam quickly one after another, fewer measurements of the background need be made than if the samples are measured independently. The effort saved by doing this is important in all spectral regions and is particularly important in the far infrared where long times are required for good spectra.

A multiple sample holder for use at room temperature is easily designed, but the problems become more serious if the samples must be cooled by, for example, liquid nitrogen. Then, either the coolant and the sample holder must be rotated together, or the coolant kept fixed and heat transferred from the sample holder through a rotatable device.

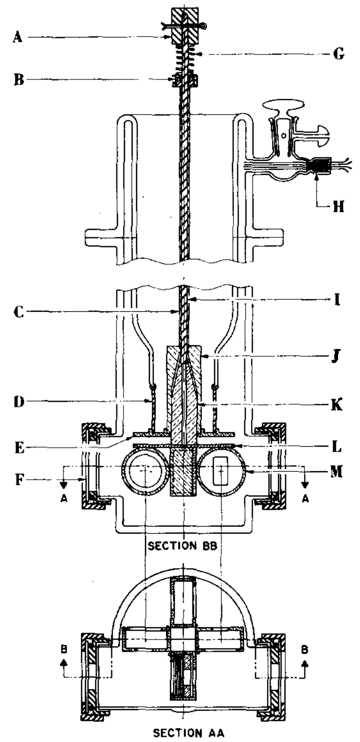

FIG. 1. Sectional views of the optical cell.

The rotation must, of course, be accomplished without breaking the vacuum that is required. Both these solutions are possible, but in this paper a cell with a fixed coolant and a rotatable sample holder suitable for liquid-nitrogen temperature is described.

The cell is shown schematically in Fig. 1 using two sectional views AA and BB. Its novel feature is the copper socket J and rotatable cone K. The socket and cone are shown slightly apart in Fig. 1 for clarity; in the actual cell they touch one another. The socket is directly cooled by the coolant in the reservoir, and in turn it cools the cone K which is connected directly to the sample holders M. To facilitate heat transfer between them the cone and socket are well lapped together, and to allow rotation without galling they are lubricated with molybdenum disulfide power.

The cone is soldered to the rod I and is rotated by rotating I by means of the square block A which is pinned to I. The cone-socket is not, of course, liquid or gas tight. To provide a tight seal the tube C, through which the rod I passes, is soldered to the socket. C and I are sealed together by an O-ring B at the upper end of the tube C. The force exerted by the spring G must be much greater than the force of the atmosphere on the rod I when the cell is evacuated (about 90 gf) in order to keep the cone and socket in good contact. Plate E is soldered to the Kovar tube D which is in turn sealed to the inner wall of the Dewar vessel.

The four sample holders M are soldered to the plate L, which is either integral with the cone K or soldered to it,