Laser Uranium Fluorimeter-A laser based uraniuum fluorimeter which may be used for exploration of uranium has been developed. The instrument can measure trace uranium in aqueous solutions, including naturally occuring waters upto one ppb level..

Most of the available techniques are indirect, requiring considerable chemical separation and are time consuming. Thus they are unpractical for purposes of hydrochemical exploration. The present technique is not only rapid but also does not require any chemical preconcentration.

Uranyl salts emit a characteristic fluorescence with three peaks at approx. 496, 514 and 540 nm, under UV excitation. The fluorescence thus produced can be measured quantitatively by a suitable photodetector.

The most serious interference in direct trace analysis of natural waters by this technique is due to dissolved organic compound which emits intense blue ,fluorescence and weak longer wavelength emission. This interference is considerably reduced by using a suitable optical filter and utilizing the difference in lifetimes of uranyl fluorescence and that of organic compounds in solution. The fluorescense lifetimes of most organic molecules seldom exceeds a few tens of nanosec, whereas uranyl ion fluorescence persists for a few tens of microsec. The analytical procedure involves the addition of a buffered complexing reagent to convert various uranyl species present into a single form for high luminiscence yield.

In the present set up, UV source is an indigenously developed small N_2 laser. The parameters of N_2 laser are: peak power 50--KW, pulse duration 10 nsec, wavelength-- 337nm, frequency 5-10 Hz. This UV beam is focussed on quartz sample cell. The fluorescence from contents of the sample cell passes through an optical filter that transmits light with wavelength longer than 450 nm only. The fluorescence light is detected by a PMT (photo-multiplier tube) which is electrically gated such that its output is available 15-20 microsec. after the laser pulse. Each output fluorescence pulse is integrated, digitized and an average value for about 50 pulses is stored. The laser output is monitored by a phototube and the peak power is again averaged for 50 pulses. The ratio of fluorescence and power output provides a quantitative measure of concentration of uranium in unknown samples.

50mm dia copper vapour laser-A copper vapour laser(CVL) giving 25W average power has been developed. Shown below is the basic scheme of this CVL system.

Operating temperature of laser is 1500^0C and is achieved by repetitive pulse discharge through helium, in the discharge tube. The average electrical power required to reach the operating temperature is 5.5 K watt. Once the operating temperature is reached, there is sufficient pressure of vapour of copper available for excitation. The same pulse discharge is used for achieving population inversion required for obtaining lasing. The laser has given 25 watts of average power with helium as buffer gas. If neon is used as a buffer gas instead of helium, the same laser will give 35 watts of average power.

Cryo-refrigerator. Cryogenics Group supplied a 20 K closed cycle helium cryo-refrigerator to Nuclear Physics Division, BARC, Bombay. Such cryo-refrigerators, working on Gifford Mc-Mahon (G-M) cycle are characterized by their simplicity and very high reliability. They supply small refrigeration loads of the order of a few watts only but have found ready applications, viz. cooling of electronic devices such as Masers in space communication systems, cooling of infrared detectors and cryo-pumping in space simulation and high energy accelerators.

The novel design of the cryo-refrigerator developed at CAT is that it uses a very simple spool valve mechanism, which is very easy to fabricate and assemble, whereas other design uses a crank actuated valve mechanism which is very complicated to fabricate. The unit supplied to BARC was run continuously at CAT for nine days (day and night) with a dummy aluminium sample of 50 mm length & 10 mm dia. A temperature drop of only four degrees was observed along the sample and the minimum temperature obtained was 8.8 Kelvin.

Equipment Commissioned

Vertical height measuring instrument. A vertical height measuring instrument TRIMOS VERTICAL TVD 1300 A with EPSON HX-20 Computer has been commissioned in the workshop. The instrument with high measuring accuracy and easy reading digital display will enable

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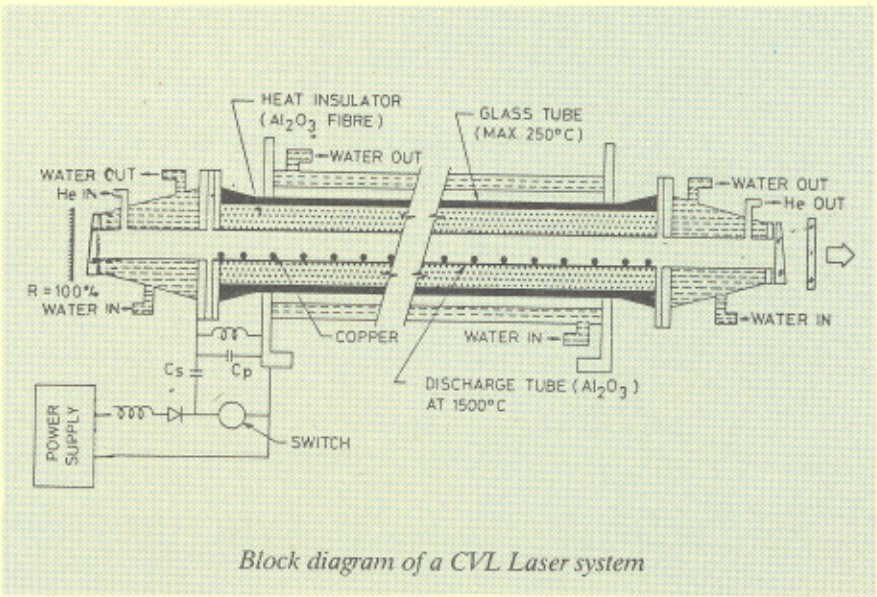

Block diagram of a CVL Laser system