experimental flexibility was necessary to determine the optimum discharge geometry. Typical elements of this device are large bored quartz discharge tubes (> 10 mm ID) and its lack of any additional magnetic field, generally utilized in common ion laser devices. Settling of length and diameter have been made to fit the power supply with a maximum available power of approx. 160 kW corresponding to 300 A, 500 Vdc. The maximum current density is appoximately 265 A/cm^2.

120-watts total power summed up over the ArII($4p \rightarrow 4s$) levels, about 20 watts in the KrII lines, and 1.5 watts ultraviolet power in ArIII (3638 Å, 3511 Å), KrIII (3507 Å) being obtained in continuous mode operation. The high inversion densities of 7×10^9 cm^{-3} (ArII 4880 Å) give rise to nonresonant laser oscillations; by multipass amplification the spontaneous emission is amplified up to 20 W/cm^2, having a beam divergence of about 10^{-4} rad.

Results indicate that the influence of radiation trapping effects on the visible Ar-laser power is smaller than estimated by others, under conditions deviating from optimum conditions for maximum laser power.

17.9 High-Power CW Ultraviolet Ion Lasers,[1] W. B. Bridges, A. S. Halsted, and G. N. Mercer, *Hughes Research Laboratories, Malibu, Calif.*

This paper reports the results of a series of investigations undertaken on CW noble gas ultraviolet ion lasers. We have obtained up to 2.3 W CW UV output power from these tubes, substantially greater than that reported previously.[2–6] A maximum efficiency of approximately 0.01 percent has been obtained in a practical tube design. A total of 31 violet and ultraviolet laser lines were observed in Ne II, Ar III, Kr III, and Xe III.

The work has included the design and development of laser structures capable of carrying discharge current densities of 1600 A/cm^2 and dissipating up to 600 W/cm of bore length. The 50-cm-long bore structure of these tubes is formed by a series of metal disks separated by quartz spacers and aligned and held in place by a water-cooled precision-bore outer quartz jacket. Two particular critical problem areas which have been investigated are gas-pumping effects and radiative heat transfer at high steady-state levels of current density and power dissipation.

At low-power input levels, the temperature gradient between the center and edge of the disks in a disk bore tube is negligible, and a uniform temperature analysis[7] of the problem may be used to find the effective emissivity of the structure. At the power levels of interest in UV lasers, the radial temperature gradient in the disks becomes quite important, and the thermal characteristics of the structure are no longer given accurately by the constant temperature approximation. For this reason, an investigation of heat transfer in a disk structure with a radial gradient was undertaken. A computer analysis has been developed which yields the radial temperature distribution as a function of disk material, dimensions, and input power level.

The strongest UV ion laser line occurs at 363.8 nm. This line has been tentatively identified by McFarlane[8] as Ar III ($^2D°$) $4_p{}^1F_3 \rightarrow$ ($^2D°$) $4s^1D_2$ by analogy with the laser lines observed in Cl II. No levels of the ($^2D°$) singlet system are known absolutely. Using the properties of exchange integrals and known spectral lines in the iso-electronic sequence sulfur I through vanadium VIII, the energies of the "tentative" levels of the 363.8-nm line have been calculated as well as other levels of the ($^2D°$) singlet system. The predicted wavelength of the transition is quite close to 363.8 nm. Using the high power CW UV laser we have made attempts to prove out this identification and to identify other members of the singlet system with previously unclassified lines in argon by a simple method of correlation spectroscopy. In this method, the upper laser level population is modulated by intracavity chopping. Correlations with spontaneous emission lines are then sought by synchronous detection. Several correlations have been found, and we are now attempting to fit these wavelengths to the isoelectronically predicted levels of the singlet system.

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