BULLETIN DE L'ACADÉMIE
POLONAISE DES SCIENCES
4. Volume XXIII, No. 12 — 1975
Série des sciences techniques

Experimental Studies of Uniformity of Positive Column of He-Cd$^+$ Laser Discharge

by

J. K. MIZERACZYK and J. ZIEMANN

Presented by R. SZEWALSKI on September 25, 1975

Summary. The results of experimental studies of uniformity of positive column of He-Cd$^+$ laser discharge are presented. It appears that the positive column is uniform in the discharge conditions typical of He-Cd$^+$ laser. However, a deviation from uniformity was monitored for another discharge conditions.

1. Introduction. The study of uniformity of positive column (PC) of He-metal laser discharges in tubes of cataphoretic type (Goldsborough [1], Sosnowski [2]) is attracting attention for the improvement of the design and performance of the He-metal lasers.

Up to date only one experimental work is known (Sosnowski [2]) concerning the study of uniformity of positive column of He-Cd$^+$ laser discharge. However, the results presented in [2] do not comprise the conditions typical of PC He-Cd$^+$ lasers. Besides, behaviour of only one parameter describing a distribution of cadmium atoms along the tube was reported, and no other information on behaviour of another important parameters of plasma of the positive column is given. The purpose of the present work was to examine experimentally the axial distribution of helium and cadmium atoms as well as the electric field in cataphoretic He-Cd$^+$ laser discharge tube in a wide range of discharge conditions, comprising also those typical of the lasing.

2. Experiment. The configuration of discharge tube used in this experiment was similar to that of Sosnowski [2]. The tube was 50 cm in length and 3 mm in diameter. The side-arm cadmium source was placed in the center of tube. All parts of the tube, except the small region of cadmium condensation, were put in the oven at a temperature of 350 ± 7.5°C. The side-arm temperature controlled separately was stabilized to better than $\pm 1/2$°C. Along the tube 23 electric probes were placed at nearly equal distances. The length and diameter of each probe were 0.5 mm and 0.2 mm, respectively.

The experiment was made over the following range of parameters: the discharge current, 15—155 mA, helium pressure, 3 torr, cadmium vapour pressure, 10^{-5}

-10^{-2} torr (it corresponds to temperature of Cd source of about 150—270°C). The electric field was obtained from measurements of potential differences between probes. Several side-light intensities of He, Cd and Cd^+ spectral lines were measured as functions of distance along the discharge tube. For this purpose a monochrometer automatically drawn along the length of the tube was used, and signal from photomultiplier tube attached to it was recorded directly on an $x-y$ chart recorder. Because of the deposits formed on the inside walls of the discharge tube, the procedure of Sosnowski [2] was used for getting the correct distributions of side-light emission along the tube.

3. Results and discussion. The results of measurements can be divided into two groups.

The first group comprises the results obtained for a temperature of Cd source up to 230°C which is the upper limit of lasing conditions at 441.6 nm (Mizeraczyk [3]). Typical results of measurements of the distribution of 477.9 nm Cd side-light

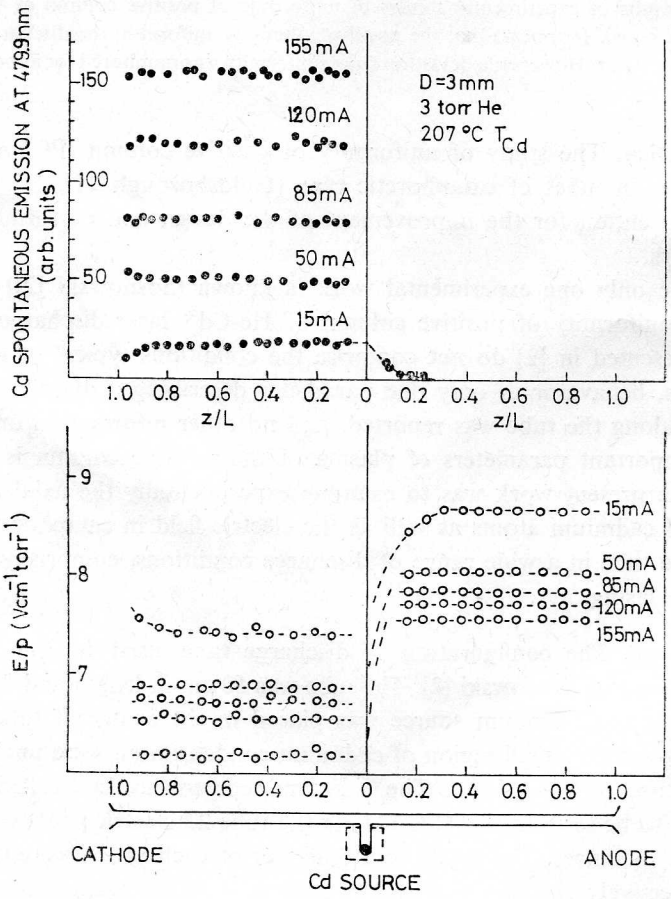

Fig. 1. The variations of 479.9 nm Cd sidelight intensity and reduced electric field E/p along the cataphoretic He-Cd^+ laser discharge tube for various currents, at a temperature of Cd source typical of laser conditions (L — distance between Cd source and electrode, z — distance from Cd source)