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0.615 μm CW Laser Action in a Positive Column He-Hg^+ Laser with Mercury Cathode*)

by

J. MIZERACZYK, J. KONIECZKA, Z. ROZKWITALSKI, J. ZIEMANN

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Summary. CW laser action at 0.615 μm in a positive column type He-Hg^+ laser using a mercury cathode is reported. The 0.615 μm sidelight spontaneous emission measurements suggest that the Penning ionization collisions between the He metastable atoms and the Hg metastable atoms can be an important process of excitation of the Hg^+ 0.615 μm laser line in addition to the charge transfer process.

Laser action in excited ionic states of a metal was first observed from the Hg-ion [1]. The laser oscillation occurred there in a pulsed positive-column arc discharge. Since then laser oscillations in ion-metal vapors were widely investigated (see, e.g., the review papers [2, 3]). Although mercury is a promising laser material because

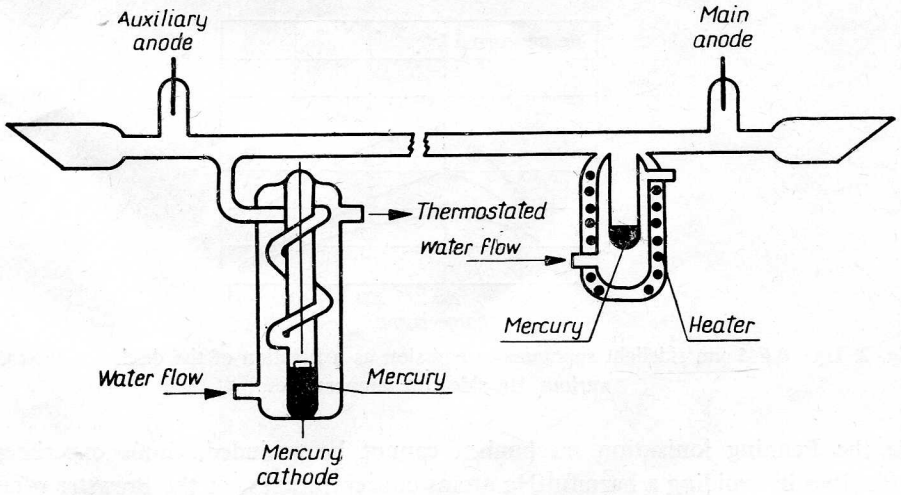

Fig. 1. The diagram of the He-Hg discharge tube with a mercury cathode

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of its favorable vapor pressure at room temperature, amenable chemical properties, relatively simple energy state structure and relatively high laser gain at several lines, only a few papers on laser action in Hg^+ have been reported (see e.g. [2, 3]). They concerned laser action from Hg^+ mainly in pulsed or continuous hollow-cathode discharges. Lately the CW laser actions at 0.615 μm and 0.7945 μm in a positive column type He-Hg^+ discharge were obtained [4, 5]. The results presented in [4] and [5] suggest that the charge transfer collision is a predominant process causing excitation of the upper laser level of He^+ but the possibility of excitation

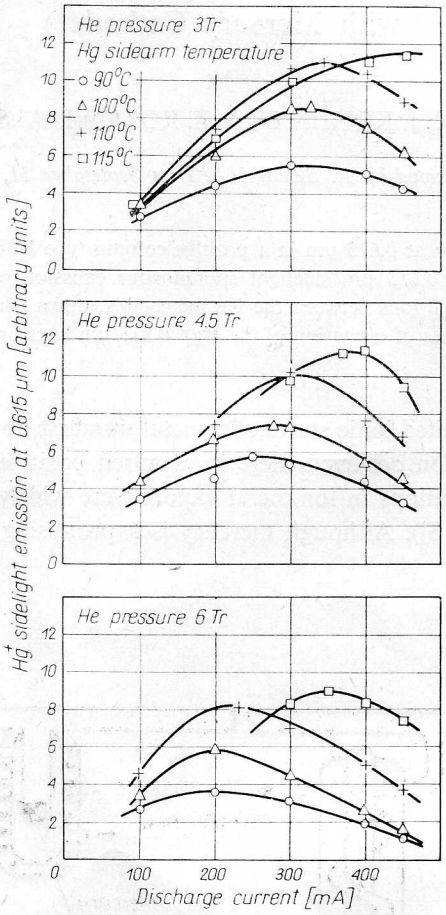

Fig. 2. Hg^+ 0.645 μm sidelight spontaneous emission as a function of the discharge current for various Hg side-arm temperatures

via the Penning ionization mechanism cannot be excluded. Some experimental difficulties in avoiding a harmful Hg atoms concentration near the Brewster window at the cathode region of the tube are mentioned in both the papers.

CW laser oscillation at 0.615 μm in a positive column type He-Hg^+ discharge, taking place in the tube with a mercury cathode (Fig. 1), is reported here. The discharge tube was about a 1 m pyrex capillary with a bore diameter of 3 mm.