Construction of a practical sealed-off He–I$^+$ laser device

T Goto, H Kano, N Yoshino, J K Mizeraczyk† and S Hattori
Department of Electronics, Nagoya University, Nagoya, Japan

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Abstract By improving the system for control of iodine vapour pressure with molecular sieves in a positive-column He–I_2 discharge, it has been possible to construct a stable sealed-off He–I$^+$ laser device for the visible region. It has a total laser power of 20–30 mW for five visible lines, and a lifetime longer than 1000 h. Details of the construction and operation of the practical He–I$^+$ laser are reported. The characteristics of the laser power are also described.

1 Introduction

Pulsed laser oscillation in singly ionized iodine was observed first in 1964 by Fowles and Jensen. CW laser oscillation was realized for only one transition (612·7 nm) in a He–CdI_2 gas mixture in 1972 by Collins *et al*, and then for ten visible and near-infrared transitions in a hollow-cathode He–I_2 discharge by using a flowing-gas system (Piper *et al* 1972).

Until then, continuous laser oscillation in the positive column He–I_2 discharge had not been realized, perhaps because of high iodine vapour pressure, 100–200 Pa, at room temperature. In the past, we had no way of overcoming this problem except by the use of an inconvenient cooling system. Previously we developed a method to control it by using molecular sieves and obtained cw laser oscillation of five visible lines (Hattori *et al* 1974a) in singly ionized iodine which were excited by charge transfer collision (Shay *et al* 1975).

The hollow-cathode laser using the flowing-gas method developed by Piper and Webb (1973) may be promising as a high-power laser because they have not observed any saturation of laser power with increasing discharge current (Piper 1974). In constructing a practical sealed-off laser, probably the positive-column discharge is preferable to the hollow-cathode discharge because we can use the convenient cataphoresis effect to control metal vapour pressure and utilize the technique and simple tube used in He–Ne and He–Cd$^+$ laser systems.

From these results and speculation, we have made the first sealed-off He–I$^+$ laser using positive-column discharge (Hattori *et al* 1974b). The total laser power of five visible lines

† Present address: Institute of Fluid Flow Machines, Polish Academy of Science, Gdańsk, Poland.