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Determination of plasma temperature of copper vapour laser

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The output power and the temperature profile of a copper vapour laser were investigated versus frequency with various kinds of back mirror in its resonator cavity. A semi-experimental method was used for measuring the plasma temperature and obtaining the temperature profile with various back mirrors. The obtained plasma temperature through this method has good agreement with the operational temperature of the laser.

1. Introduction

The copper vapour laser (CVL) is one of the efficient sources of coherent light in the visible region at 510.6 and 578.2 nm with high average power. CVLs have wide applications in research, medicine and industry. Moreover, they are considered to be a powerful pumping source for dye lasers (Withford *et al.* 2004), particularly by means of a master oscillator-power amplifier array, in order to satisfy higher output powers and beam quality simultaneously (Behrouzinia, Sadighi & Parvin 2003; Aghababaei Nezhad *et al.* 2010). The plasma temperature and electron density are most important parameters that affect the operation of gas lasers such as CVLs. Under a local thermodynamic equilibrium (LTE) condition in the plasma, the excitation temperature governing the distribution of energy level excitation through the Boltzmann equation and the ionization temperature governing the ionization equilibrium through the Saha equation, are equal to the electronic temperature describing the Maxwellian distribution of electron velocities (Bakshi & Nunnally 1995; Griem 1997; Gupta & Sari 2010 for more details). Thus, a plasma in LTE has a common temperature T, called the plasma temperature. The most widely used spectroscopy method for the determination of T is the Boltzmann plot method (Griem 1997), which employs the ratio of integrated line intensities for two or more laser lines. Based on the two-dimensional heat conduction equation solved under boundary conditions of the third and fourth kind, a new approach is proposed for determining the gas temperature

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