THE OPTIMUM PUMPING POWER FOR OPTICALLY PUMPED FIR LASERS

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The relations between the output power of optically pumped FIR laser and the pumping power were studied theoretically by solving the density matrix equation of four-level system by means of the matrix signal flow graph method. The output power density of FIR laser was calculated by iteration method. A set of curves of output FIR power density against pumping power has been obtained. It has found that every of each curve has a maximum point of which the position is different for different pumping detuning. According the these results we predicted that there would exist an optimum pumping power density for an optically pumped FIR laser with certain pumping detuning. This theoretical result would help us to design the optically pumped FIR lasers.
Key words: Submillimeter wave laser, Optically pumped FIR lasers, Nonlinear optics, Multiphoton processes.

A. Introduction

Since the invention of optically pumped FIR laser, a lot of research has been done both experimentally and theoretically by many authors. (1-6) The understanding of the phenomena in the process of optically pumped lasing has been deepened. The reasonable explanations of the tuning and gain characteristics, AC Stark effect, multiphoton processes etc. have been obtained. Some interesting phenomena due to the interactions between multiphoton processes have been predicted theoretically (5), and part of them have been verified experimentally. The multiphoton processes and their contribution to the system gain may be investigated by solving the density matrix equations of the system. The gain and the FIR signal intensity have direct influence on the power output of the laser. In the past, for simplicity, many authors assumed that the intensity of FIR signal is much smaller than that of pumping intensity in the calculation of the gain. But such an assumption would lead to imperfect conclusion with some significant effects missed. In spite of this, the calculations with the assumption of small signal would be still satisfactory for analyzing and predicting the phenomena of optically pumped laser, but not for cal-