

Investigation of tunable high power CW CO₂ laser using compound cavity

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A CO₂ lasing medium has more than 100 vibration-rotational transitions in the range of 9–11 μm. In general, a diffraction grating is used as one end mirror of cavity to select individual transition. The output originates from the zeroth-order reflection of the grating. Such an arrangement only provides low power output of typically several watts. G. J. Ernst et al. proposed an out-coupling device which is equivalent to a Fabry-Perot, where one reflecting surface is the 36% reflecting germanium flat and the other one the grating. The other mirror of the cavity is still total reflecting mirror. The output also comes from the grating. A total of 144 transitions with maximum output power up to 15 W. However, this arrangement can not give high output power for high gain transitions. Were obtained. According to the proposal by G. J. Ernst et al., we used a grating and an appropriate high reflecting germanium flat as one end of the cavity, which forms a high reflecting dispersion device, a partially reflecting germanium concave mirror as the other end of the cavity. An inexpensive common glass substrate grating was used to obtain maximum output power up to 80 W of single tunable line. And the grating was not damaged at all. Moreover, since the output does not come from the grating, the output can maintain definite direction and location without any auxiliary mirror during the tuning. The total of tunable lines depends on the parameters of the compound cavity. We obtained 30–40 lines within the high gain range.

用复合腔获得可调连续 CO₂ 激光的高功率输出

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CO₂ 激光媒质在 9~11 微米范围内有 100 多条振转跃迁谱线。一般用一衍射光栅作为腔体的一个端镜进行支线选择, 由光栅的零级反射输出。这种装置只能得几瓦的低功率输出。G. J. Ernst 等提出了一个等效 F-P 的输出耦合器件, 它的一个反射面是 36% 的 Ge 平板, 而另一面为光栅。腔体的另一端仍为一全反镜。同样由光栅处输出。他们得到了最大功率达 15 瓦的 144 条谱线。但这种装置对高增益跃迁不能给出高功率输出。根据他们的提议, 我们用一光栅和一适当高反的 Ge 平板构成一高反色散器件作为腔体的一端, 另一端用部分反射的 Ge 凹镜。用一廉价的玻璃光栅得到了高达 80 瓦的原支线输出, 而此光栅则毫无损伤。而且, 不是从光栅处输出, 故无需加任何辅助镜子在调谐时便可维持输出的定向定位。可调谱线的总数有赖于复合腔的参数。我们获得了 30~40 条高增益谱线。