Effects of Plasma Formation on the Cesium Diode (DPAL) and Excimer (XPAL) Pumped Alkali Laser

ARAM H. MARKOSYAN, MARK J. KUSHNER, University of Michigan — Diode pumped alkali lasers (DPALs) and excimer pumped alkali lasers (XPALs) are being investigated as a means to convert optical pumps having poor optical quality to laser radiation having high optical quality [1]. DPALs sustained in Cs vapor are pumped on the D_2(852.35 nm), Cs(6^2S_1/2) → Cs(6^2P_3/2), transition and lase on the D_1(894.59 nm) transition, Cs(6^2P_1/2) → Cs(6^2S_1/2). Collisional mixing (spin orbit relaxation) of the Cs(6^2P_3/2) and Cs(6^2P_1/2) levels is a key part of this three-level (in fact, a quasi-two-level) laser scheme. In the five-level XPAL pumping scheme, the CsAr(B^2Σ^+_1/2) state is optically pumped by 836.7 nm pulses, which later dissociates and produces Cs(6^2P_3/2). As in DPAL, a collisional relaxant transfers the population of Cs(6^2P_3/2) to Cs(6^2P_1/2), which enables lasing on D_1 transition. A first principals global computer model has been developed for both systems to investigate the effects of plasma formation on the laser performance. Argon is used as a buffer gas and nitrogen or ethane are used as a collisional relaxant at total pressure of 600 Torr at temperatures of 350-450 K, which produces vapor pressures of Cs of <0.1 Torr. In both systems, a plasma formation in excess of 10^{14} - 10^{16} cm^{-3} occurs, which potentially reduces laser output power by electron collisional mixing of upper and lower laser levels [2].


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