



POPULATION KINETICS IN ERBIUM DOPED LASER CRYSTALS PRODUCED BY EXCITATION WITH AN Er : GLASS LASER AT 1.53 MICRONS

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POPULATION KINETICS IN ERBIUM DOPED LASER CRYSTALS PRODUCED BY EXCITATION WITH AN Er: GLASS LASER AT 1.53 MICRONSM. BIRNBAUM, K. SPARIOSU and B. VIANA⁽¹⁾*Center for Laser Studies, University of Southern California, Department of Electrical Engineering, University Park, DRB 17, Los Angeles, California 90089-1112, USA*

It is well-known that upconversion limits the performance of Er:crystal lasers at 1.6μ ($^4I_{13/2} \rightarrow ^4I_{15/2}$). The ion-ion interaction consists of $Er(13/2) + Er(13/2) \rightarrow Er(9/2) + Er(15/2)$. Thus each upconversion event leads to a loss of inversion by three. The following crystals were irradiated with the focussed light output of an Er:glass laser at 1.53μ which provided a spiked output for about 1 ms and total energy about 200 mJ: Er(0.1, 0.2, 0.5, 1, 2, 4%):YAG, Er(5%):YALO, Er(10%):YLF, Er(25%):YSGG, and Er(10%):YSO. In all cases, absorption of the 1.53μ radiation produced "bleaching", namely, reduced absorption resulting from depletion of the ground level of Er, which becomes saturated (maximum transmission of 1.53μ light).

The division of population between the ground levels of the $^4I_{15/2}$ manifold and the $^4I_{13/2}$ manifold was calculated from the changes in absorption coefficient induced by depletion of the ground state. Using the Boltzmann distribution, we computed the populations in the sublevels of the $15/2$ and the $13/2$ manifolds and found that a very large inversion was produced between the lowest sublevel of the $13/2$ manifold and the highest lying sublevel of the $15/2$ manifold. The length or thickness of our crystal samples (0.1 to 1cm) together with the computed inversion showed that there was ample gain to sustain laser action. Experiments are in progress to demonstrate laser action with the 1.53μ Er:glass laser pump.

Green light (560 nm) and infrared (980 nm) fluorescence was observed for all the crystals under 1.53μ excitation. These measurements will be used to obtain the upconversion coefficients and to determine the deleterious effects of upconversion on Er:crystal lasers. The focus of these studies is the determination of the potential utility of Er:crystals for development of an efficient room temperature Er:crystal laser at 1.6μ .

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