use of IBM-7074 computer. The computed values of v_m are tabulated in Table V and these are compared with values calculated from (i) the VRH moduli and (ii) the measured polycrystalline elastic moduli presented earlier in Table I. Since the polycrystalline elastic moduli are isotropic, such a calculation of the mean velocity of sound from the polycrystalline data is simply done by the use of a Debye expression[13]

$$v_m^* = [\tfrac{1}{3}(1/v_l^{*3} + 2/v_t^{*3})]^{-1/3}, \qquad (7)$$

where v_l^* and v_t^* are the isotropic longitudinal and transverse velocities of sound, respectively, and they are defined by the isotropic longitudinal and shear moduli in the usual way.

[13] See, for example, T. H. K. Barron, Phil. Mag. **7**, [46] 720 (1955) and also Ann. Phys. **1**, 77 (1957).

It is evident from Table V that the values of the mean velocity of sound calculated from the single-crystal data agree well with that obtained from the polycrystalline data. In other words, the values of v_m^* calculated from Eq. (7) using both the VRH moduli and the actual polycrystalline moduli find in the general agreement with the v_m calculated from Eq. (6). The kind of the agreement observed here supports the earlier conclusion that the VRH approximation gives realistic values of the polycrystalline elastic moduli in terms of the corresponding single-crystal properties.

ACKNOWLEDGMENTS

The writers acknowledge Dr. Edward Carnall, Jr. for providing the Irtran samples. This work was supported by U.S. Office of Naval Research.

JOURNAL OF APPLIED PHYSICS VOLUME 38, NUMBER 6 MAY 1967

Behavior of Saturable-Absorber Giant-Pulse Lasers in the Limit of Large Absorber Cross Section

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(Received 9 January 1967)

Using a rate-equation model, it is shown that the behavior of the saturable-absorber giant-pulse (SAGP) laser can be adequately described in terms of two parameters for values of the ratio of absorber to laser absorption cross section $\sigma > 200$: n_{ai}' the normalized initial inversion and $\sigma\tau_s$, where τ_s is the normalized absorber relaxation time. In the general case, specification of n_{ai}', σ, and τ_s is required. Theoretical curves of the giant-pulse output power, energy, and rise- and falltimes are presented. The results are applicable in particular to SAGP lasers employing organic-dye absorbers.

INTRODUCTION

Recently, the saturable-absorber giant-pulse (SAGP) laser has been the subject of intensive study.[1–16] SAGP lasers might be classed into two types, depending on the nature and distribution of absorber centers in the laser cavity. The more common device uses an organic-dye absorber, which is physically separated from the amplifying medium. Such dyes have absorption cross sections which are typically 10^3 to 10^5 times larger than that of the laser centers. In the other type of SAGP laser, the absorber is uniformly distributed throughout the amplifying medium, e.g., Nd^{3+} glass co-doped with UO_2^{2+},[2] color centers in Nd^{3+} glass[3] and Ho^{3+} glass co-doped with Fe^{2+}.[4] There have also been indications of self Q-switching in ruby co-doped with Ti and Fe.[5] The absorber parameters in the latter systems are, as yet, largely undetermined.

In earlier publications[6,7] a theory of SAGP lasers was formulated in terms of three parameters, n'_{ai} the normalized inversion prior to Q switching, σ the ratio of absorber to laser cross section, and τ_s the absorber lifetime normalized to the cavity photon lifetime. It is the purpose of this paper to show that for sufficiently large σ, the SAGP laser behavior can be adequately described by only two parameters, n'_{ai} and the product $\sigma\tau_s$. The range of validity of this description is examined in detail and is shown to be a good approximation for

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