

Gain Optimization and Scaling of a Pulsar-Sustainer Discharge Excited Oxygen-Iodine Laser

J. Bruzzese, M. Nishihara, A. Hicks, W. R. Lempert, J. W. Rich and **I. V. Adamovich**¹

Michael A. Chaszeyka Nonequilibrium Thermodynamics Laboratories
Department of Mechanical Engineering, The Ohio State University, Columbus, OH 43210, USA

The paper discusses optimization of gain and output power and scaling of a pulser-sustainer discharge excited oxygen-iodine laser using adding NO to the laser mixture, iodine vapor dissociation in an auxiliary side discharge, and scaling of the pulser-sustainer discharge volume and power.

The paper presents results of gain and output power optimization, as well as scaling of a pulser-sustainer discharge excited oxygen-iodine laser. For this, NO addition to the laser mixture and iodine vapor dissociation in an auxiliary high-voltage, nanosecond pulse duration, repetitively pulsed discharge (“side” discharge) are used. Iodine dissociation fraction generated in the side discharge and measured in the M=3 laser cavity is up to 50%. The experiments showed that additional iodine dissociation generated in the side discharge only moderately increased laser gain, by 10-15%. Parametric gain optimization by varying main discharge pressure, O₂ and NO fractions in the flow, I₂ flow rate, pulsed discharge frequency, and sustainer discharge power, with the side discharge in operation produced gain up to 0.08 %/cm. Two parameters that critically affect gain are the energy loading per molecule in the discharge and the NO flow rate controlling the O atom concentration in the flow. Operation at the main discharge pressure of 60 torr resulted in significantly higher gain than at 100 torr, 0.080 %/cm vs. 0.043 %/cm, due to high discharge energy loading per molecule at the lower pressure. Laser output power measured at the gain optimized conditions is 1.4 W. Experiments with a scaled-up laser with a large volume pulser-sustainer discharge (10 cm × 10 cm × 2 cm vs. 5 cm × 5 cm × 2 cm) and longer gain path (10 cm vs. 5 cm) demonstrated stable discharge operation at discharge powers up to at least 2.9 kW. Singlet delta yield and gain measurements in the scaled-up laser are underway.

¹E-mail: adamovich.1@osu.edu