Study of COIL Active Medium with Atomic Iodine Generated via Fluorine Atoms

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A generation of atomic iodine via F atoms with their immediate injection to the supersonic COIL nozle has been studied. Very high concentrations of I atoms were obtained in the laser cavity in the absence of $O_2(^1\Delta_g)$. Low values of small signal gain measured in the $O_2(^1\Delta_g)$ flow did not correspond to high efficiency of I generation. This was ascribed to $O_2(^1\Delta_g)$ quenching by $DO_2\cdot$ radical.

A chemical method of atomic iodine generation followed by iodine injection into the supersonic nozzle of the Chemical Oxygen Iodine Laser (COIL) was studied experimentally. This method is based on the reaction of gaseous hydrogen iodide (or deuterium iodide) with fluorine atoms formed in a preceding reaction between molecular fluorine and nitrogen oxide. Iodine atoms were generated in specially designed reactors tightly attached to the laser body and then injected into the singlet oxygen flow 4 mm downstream the supersonic nozzle throat. Concentration profiles of atomic iodine along the gas flow or perpendicularly to it were measured in dependence on the flow rates of reaction gases. Very high concentrations of atomic iodine (up to 3.2×10^{15} cm^{-3}) were measured in the laser cavity when the primary gas contained no singlet oxygen. Yields of atomic iodine related to either F_2 or HI were rather high ($I/F_2 \leq 100$ %, $I/HI \leq 60$ %). A small signal gain on the I*-I laser transition was measured when atomic iodine was injected into the primary gas containing singlet oxygen. The measured gain was lower than the gain estimated from the determined concentration of atomic iodine, temperature, and $O_2(^1\Delta_g)$ yield measured upstream the iodine admixing. This difference was ascribed to the $O_2(^1\Delta_g)$ quenching by some product of DI oxidation (probably the radical $DO_2\cdot$).

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