Micro Chemical Oxygen Iodine Lasers (MicroCOIL)
Sponsorship: DARPA, MDA

Conventional Chemical Oxygen Iodine Lasers (COIL) offer several important advantages for materials processing, including short wavelength (1.3 µm) and high power. However, COIL lasers typically employ large hardware and use reactants relatively inefficiently. This project is creating an alternative approach called microCOIL. In microCOIL, most conventional components are replaced by a set of silicon MEMS devices that offer smaller hardware and improved performance. A complete microCOIL system includes: microchemical reactors, microscale supersonic nozzles, and micropumps. System models incorporating all of these elements predict significant performance advantages in the microCOIL approach [1].

Initial work is focused on the design, microfabrication, and demonstration of a chip-scale Singlet Oxygen Generator (SOG): a microchemical reactor that generates singlet delta oxygen gas to power the laser. Given the extensive experience with microchemical reactors over the last decade [2-4], it is not surprising that a microSOG would offer a significant performance gain over large scale systems. The gain stems from basic physical scaling; surface to volume ratio increases as the size scale is reduced, which enables improved mixing and heat transfer. The SOG chip being demonstrated in this project employs an array of microstructured packed-bed reaction channels interspersed with microscale cooling channels for efficient heat removal. Figure 1 shows a schematic top view of the microSOG chip, including inlets and outlets for the reactant and product flows, and packed-bed reaction channels. Figure 2 shows a schematic diagram of stacked microSOG chips, micronozzles, and micropumps forming a complete microCOIL system.

REFERENCES: