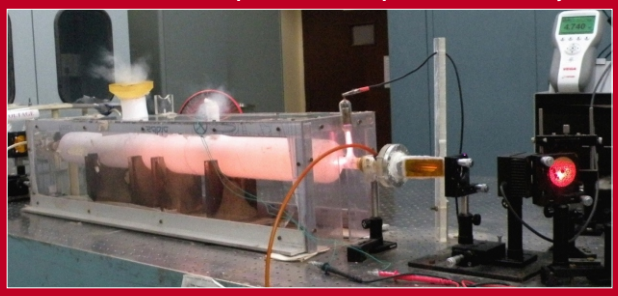
Experimental setup of the CO laser system



CO laser emission spectra in 5 µm region from the gas discharge for 90% output couplers

A Novel CO Laser

Lasing action in 5 µm region occurring from CO molecules formed inherently in a CO_2-N_2-He gas discharge lead to applications in spectroscopy & material processing

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CO_2 laser is the most powerful coherent source providing discretely tunable emission over the 9-11 µm region of the electromagnetic spectrum. Discovered in 1964, it is one of the most well researched lasers and has found its way into countless research papers published worldwide[1]. The laser dynamics is therefore well understood and active research is now confined to its applications in various disciplines. However, one aspect of CO_2 laser that has hitherto remained experimentally unexplored is its emission spectrum when the gain cell is subjected to LN_2 cooled conditions (77 K), understandably, owing to the freezing of the CO_2 gas at such low temperatures. We have reported for the first time[2], the operation of a free running CW-CO_2 laser when its gain cell is subjected to LN_2 temperature. Of particular interest is the observation of rich multi-line emission spectrum spanning over 4.95 µm to 5.49 µm. These findings are very significant, as they establish, for the first time, the laser emission in 5 µm region originating from CO molecules that are formed inherently in CO_2 laser discharge (comprising CO_2-N_2-He) due to electron impact dissociation. This has rendered the utilization of highly toxic extraneous CO gas source for obtaining lasing in the 5 µm region redundant. In another study, the laser was characterized to know the constituents of the gain medium, in particular, the CO concentration (active species). In the absence of the knowledge of the lasing medium apriori, FTIR based analysis of the exhaust of the flowing type CO laser enabled us to characterize the change in the lasing mixture composition as a function of coolant temperature[3]. Laser power exceeding 15 W was obtained in 10 µm region (CO_2 laser output) and ~10W of 5 µm (CO power), indicating ~60% conversion efficiency[3] under these operating conditions. In another work reported in the literature, it has been demonstrated that a 20 W CO laser cutting of polyethylene has about the same effect as that of a 150 W CO_2 laser[4]. Further optimisation of this laser is being carried out. Potential applications include molecular spectroscopy and material processing.

[1] The CO_2 laser; W J Witteman, Springer series in optical sciences, Springer-Verlag (1987).

[2] Cryogenically cooled CW electric discharge CO laser operated with CO_2 laser mixture; M. B. Sai Prasad, Tatsat Dwivedi, J. P. Nilaya*, Shailesh Kumar and D. J. Biswas, Laser Physics, 2018, 28 (12), 125002.

[3] Experimental estimation of CO concentration in LN2 cooled CW-CO laser operating with CO_2 laser gas mixture; Tatsat Dwivedi, Ayan Ghosh, M. B. Sai Prasad and J. P. Nilaya*, Laser Physics Letters, 2022, 19 (9), 095001.

[4] www.photonics.com/Articles/New CO laser technology offers processing benefits/a57681.

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