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Carbon monoxide laser on extra-high vibrational transitions

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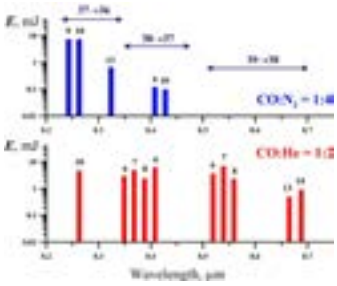
Because of its extremely broad spectrum, CO laser is a very attractive object for enriching and expanding spectrum of laser systems applying such a laser into short- and long-wavelength region of mid-IR. By frequency conversion of their radiation in nonlinear optical crystals their spectrum was expanded down to ~2.5 μm and up to ~17 μm]. Up to now CO laser could emit hundreds of ro-vibrational lines within wavelength region from ~4.7 μm for the lowest vibrational transition 1→0 up to ~8.2 μm for high vibrational transition 37→36. The objective of our study is to understand which physical processes result in limitation of long-wavelength border for a CO laser spectrum and what the longest wavelength is. The CO laser emitting on the extra-high ever observed vibrational transitions up to 39→38 with wavelength of 8.7 μm was for the first time launched. It should be noted that multi-quantum vibration-to-vibration VV exchange does play an important role in molecular kinetics on high vibrational levels of CO molecule. Population redistribution among the high vibrational levels is very important for development of a first-overtone (V+2→V) CO laser. Factors limiting the longest CO laser wavelength are discussed. The longest CO laser wavelength was experimentally demonstrated to be limited by asymmetric two-to-one quantum VV exchange between CO molecules in nitrogen-free gas mixture. In nitrogen-containing gas mixtures the longest wavelength is limited by inter-molecular asymmetric two-to-one quantum VV' exchange between carbon monoxide and nitrogen molecules. Expansion of CO laser spectrum to longer wavelengths gives an opportunity to fill in a spectral gap between 8 and 9 μm, and thereby to increase an opportunity of IR laser spectroscopy for environmental monitoring and other applications connected with propagation of laser radiation through the atmosphere.



Biography

Andrei Kotkov has his expertise in Laser Physics. He received his MS degree from the Moscow Physical-Technical Institute (State University) in 1982 and his PhD degree from the P N Lebedev Physical Institute (LPI) in 2001. He is Associate Professor focusing on Laser Physics at the LPI.

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