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Infrared laser system through mixing molecular gas lasers

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In mid-IR range molecular gas lasers can simultaneously emit dozens or hundreds of spectral lines. The spectral lines of gas lasers are quite narrow, but they are located relatively rare. A carbon dioxide CO₂ laser can emit dozens spectral lines in the wavelength range from 9 to 11 microns. A carbon monoxide (CO) laser operating on fundamental and first-overtone vibrational transitions has an extremely broad emission spectrum consisting of more than a thousand spectral lines in the wavelength range from 2.5 to 8.2 microns. However, all laser lines do not cover entirely specified spectral ranges. To enrich and expand the laser spectra, it is worth to apply the frequency conversion in nonlinear crystals. To enrich CO laser spectrum, frequency conversion in ZnGeP₂ (ZGP) crystal was applied. Hundreds of new spectral lines were obtained due to sum-frequency generation (SFG) as the first stage and difference-frequency generation (DFG) as the second stage of two-stage frequency conversion. The ZGP crystal is a very efficient nonlinear crystal but it is transparent only up to 12 μm. Then for mixing CO and CO₂ laser light we used AgGaSe₂ (AGSe), GaSe, and PbIn₆Te₁₀ (PIT) crystals. Application of AGSe crystal as a frequency converter of CO and CO₂ laser radiation resulted in 16.6 μm DFG. The conversion efficiency of DFG under mixing CO and CO₂ laser light in AGSe appeared to be 20 times that of GaSe, which probably is related to high birefringence of the latter resulting in high spatial walk-off effect. We believe that the developed laser system can be a prototype for the development of IR laser systems and would be useful in a variety of researches and applications.



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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