2002 SPIE International Symposium on Optical Science and Technology
"Diode Lasers and Applications" – AM109
7–11 July 2002 | Washington State Convention Center | Seattle, Washington USA

Tunable Optical Fiber Pumped Difference Frequency Laser Sources: State-of-the-Art

Invited Talk

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Abstract: In this presentation, the development and application of various state-of-the-art mid-infrared diode laser based sources will be reviewed and their future potential as a versatile precision spectroscopic tool will be highlighted.

Laser based gas detection and monitoring techniques have now evolved to a mature level. The requirements for tunable laser sources have been mostly identified, both in terms of user-friendly operation and spectroscopic performance to achieve the best possible sensitivity and precision for a given spectroscopic technique. Critical laser performance parameters include spatial beam quality, usable IR power, linear frequency tunability and stability. For continuous-wave, long-path absorption spectroscopy, the development of robust mid-infrared spectroscopic sources has led to numerous selective, sensitive and real-time gas monitoring applications. These new compact and tunable spectroscopic sources (<0.5 cubic feet) can be designed for efficient room-temperature operation in the 2.4 - 4.6 microns wavelength region using standard near-IR telecom lasers that are optically mixed in nonlinear optical materials such as periodically poled $LiNbO_3$ (PPLN). Wavelength multiplexing and flexible dispersion control of PPLN crystals offer convenient narrow-linewidth (100 kHz - 2 MHz), single or multiple-frequency mid-IR operation at the milli-watt level. This permits the sensitive detection of many molecules such as HF, HCl, CH_2O, CH_4, CO_2, CO and N_2O at their strong fundamental rotational-vibrational transitions using direct, dual-beam, 2-f and other advanced spectroscopic detection schemes. At this wavelength region, these new laser sources provide an ideal

alternative to cryogenically cooled lead-salt diode lasers. This talk will focus on the comparison of the two technologies with an emphasis on achieving ultra-high sensitivity in ground and airborne applications.

Biography: Dr. Richter received his undergraduate education at the University of Applied Sciences Emden, Germany, and received his engineering diploma in ' Applied-Laser-Technology' in December 1997. He performed his diploma-thesis work on diode laser based mid-IR sources and their applications in Prof. Frank Tittel' s Laser Science Group at Rice University, Houston, TX. Dr. Richter continued research at Rice University to pursue the development and application of tunable diode and optical fiber based mid-IR sources in Prof. Tittel' s group and completed his Ph.D. work at Rice University in November 2000. Dr. Richter then joined the National Center for Atmospheric Research in Boulder, Colorado as Postdoctoral Fellow to work with Dr. Alan Fried to utilize and implement the latest optical telecom technologies for the development of robust mid-IR laser sources for high-precision airborne trace gas measurements.

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