MULTIPLEX MID-IR SPECTROSCOPY WITH Cr^{2+}-BASED LASERS

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Laser operation of Cr^{2+}-doped chalcogenides has been demonstrated in the mid-nineties and has led to a new class of efficient mid-infrared laser crystals. Among them, Cr^{2+}:ZnSe and Cr^{2+}:ZnS represent interesting alternative to difference frequency generation and semiconductor lasers for spectroscopy. They indeed exhibit[a] broad tunability in the 2.5 μm region, high-power room-temperature operation and compactness, especially with fiber or diode lasers pumping.

In this paper, we report application of Cr^{2+}:ZnSe and Cr^{2+}:ZnS lasers to high-resolution and high-sensitivity intracavity absorption spectroscopy (ICLAS) analyzed by time-resolved Fourier transform (TRFT) spectroscopy. ICLAS with an evacuated tunable Cr^{2+}:ZnSe laser is performed with a high-resolution TRFT interferometer with a minimum detectable absorption coefficient equal to 4 10^{-9} $cm^{-1}Hz^{-1/2}$ around 2500 nm[b]. This is the extreme limit presently reached in the infrared by ICLAS with Doppler limited resolution. The broad gain band of the crystal allows a spectral coverage at most equal to 125 nm, wide enough to see entire vibration bands. Weak CO_2, N_2O[c] and C_2H_2[d] bands are observed for the first time in a laboratory and their analysis is discussed. Relatively to Cr^{2+}:ZnSe, Cr^{2+}:ZnS has a blue-shifted emission, peaking around 2.4 μm, making it especially attractive for applications in this water-free window of the atmosphere. We report first spectroscopic application[e] of a Cr^{2+}:ZnS laser. We indeed demonstrate a broadband Cr^{2+}:ZnS laser for ICLAS, utilizing Er-fiber or direct diode pumping. Illustration is provided with spectra of weak bands of N_2O.

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