INTRACAVITY LASER SPECTROSCOPY WITH A Co:MgF_2 LASER IN THE 1.6-2.5 μm REGION–ULTRASENSITIVE TECHNIQUE FOR TRACE GAS MONITORING

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The characteristics of a Co:MgF_2 laser are examined with respect to intracavity laser spectroscopy. This laser can be operated in a CW regime and has the broad tunability range from 1.6 to 2.5 μm. Many vibrational and overtone transitions of molecules and radicals appear in this spectral region.

Optically pumped by 1.34 μm laser radiation, the broadband pulsed Co:MgF_2 laser has been operated at room temperature. We were able to obtain 1-ms-duration pulses. The IR Co:MgF_2 laser radiation has been up-converted to visible region and spectrally analyzed by a grating spectrograph. The spectra were recorded by a CCD array. The spectral resolution of the recording was 0.05 cm^{-1}. The intracavity absorption spectra of atmospheric carbon dioxide and water vapor were recorded in the $2.03 - 2.06$ μm spectral region. The intracavity absorption spectra of ammonia, methane, ethane, methanol, water vapor, methyl iodide, and transient products of flash photolysis of acetone were recorded in the $2.23 - 2.25$ μm spectral region. The linear growth of the intracavity absorption was observed for the generation time values from 0 to at least 1 ms which is equivalent to the detection sensitivity of $3 \cdot 10^{-9}$ cm^{-1}. Numerous atmospheric trace gases with resolved absorption spectra can be monitored at the ppb-level concentrations (1 part in 10^9) with this sensitivity.