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

N. PICQUÉ, G. GUELACHVILI, H. HERBIN, R. FARRENQ, V. GIRARD, *Laboratoire de Photophysique Moléculaire, Unité Propre du C.N.R.S., Bâtiment 350, Université de Paris-Sud, 91405 Orsay, France, email: nathalie.picque@ppm.u-psud.fr* ; E. SOROKIN, I.T. SOROKINA, *Institut für Photonik, TU Wien, Gusshausstr. 27/387, A-1040 Vienna, Austria*.

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.

---

[a] I. T. Sorokina, Optical Materials 26, 395 (2004).

[b] N. Picqué, F. Gueye, G. Guelachvili, E. Sorokin, I.T. Sorokina, Optics Letters 30, 3410-3412, 2005.

[c] H. Herbin, G. Guelachvili, N. Picqué, E. Sorokin, I.T. Sorokina, N_2O weak lines between 3900 and 4090 cm^{-1} from long path absorption spectra, submitted for publication, 2006.

[d] V. Girard, R. Farrenq, E. Sorokin, I.T. Sorokina, G. Guelachvili, N. Picqué, Chem. Phys. Lett. 419, 584-588, 2006.

[e] E. Sorokin, I.T. Sorokina, G. Guelachvili, M. Jacquemet, N. Picqué, Broadband mid-infrared Cr^{2+}:ZnS laser-based spectrometer, submitted for publication, 2006.