F1

PRECISION BROADBAND SPECTROSCOPY IN THE TERAHERTZ REGION

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Precision broadband spectroscopic measurements have been performed in the spectral region up to 1.1 THz. Continuous frequency coverage is achieved by employing frequency and phase stabilized Backward Wave Oscillators (BWOs). This breakthrough in high-resolution scanning spectroscopy with microwave accuracy and hitherto unparalled sensitivity became possible by the opening of the borders between East and West and essentially by the collaborative technical efforts between Cologne University, Germany, and the Institute of Applied Physics, Nizhnii Novgorod, Russia[a]. Extensive measurements have been performed on HSSH, HOOH, their various isotopomers, and astrophysically relevant molecules and radicals, such as SO_2, H_2S, H_2CO, SO and NO. Some of their spectra will be presented.

The essential components of the Cologne spectrometer system (2) consist of the high-frequency, broadband tunable BWOs supplied by the ISTOK Research and Production Company (Fryazino, Moscow region), a newly designed multiplier-mixer with low noise HEMT amplifier circuitry, two precision tunable millimeter wave synthesizers (78 to 118 GHz; 118-178 GHz from the Institute of Electronic Measurement, KVARZ, Nizhnii Novgorod), and a He-cooled InSb-detector.

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F2

BROADENING AND SHIFT OF H_2O SPECTRAL LINES IN VISIBLE SPECTRAL RANGE INDUCED BY H_2, H_2O, CH_3–CO–CH_3, AND AIR

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The results of the half-widths and shifts of the H_2O absorption lines of 103 and 401 vibrational bands due to collisions with molecules were obtained using two types of photo-acoustic spectrometers (PAS) of high resolution.

The intracavity laser PAS with CW dye laser was applied to the measurements of broadening and shift of H_2O vibration-rotation lines in 401 band. The perturbing gases like air and CH_3–CO–CH_3 were tested.

The PAS with pulsed ruby laser was used for investigating the half-width and shift of the H_2O absorption lines (103 band) in binary gaseous mixtures with H_2, CH_3–CO–CH_3, and air. The self-broadening and self-shift were also measured.

The procedure of the half-width and shift measurements vs gas temperature is specially discussed as well as the experimental data. The behaviour of H_2O spectral line-shape parameters under variation of the quadrupole or dipole moment of the purturbed molecule is considered. The new phenomena in spectral line shape behaviour at collisions of MH_x molecules with H_2 or another molecules containing hydrogen atoms were obtained experimentally and their preliminary interpretation is given.

F3

OPTICAL-OPTICAL DOUBLE RESONANCE POLARIZATION SPECTROSCOPY OF HIGHLY EXCITED STATES OF $^{23}Na^{39}K$ MOLECULE

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Highly excited states of $^{23}Na^{39}K$ molecule were studied by the sub-Doppler optical-optical double resonance polarization spectroscopy (OODRPS) using two single mode lasers. In a hetero-nuclear diatomic molecule, the gerade and ungerade symmetry in a homonuclear diatomic molecule disappears, and the more electronic transitions and perturbations become allowed. OODRPS is a very useful technique for studying the highly excited levels even affected strongly perturbations. The spectrum is simplified because transitions from a only chosen vibrational-rotational level are observed. We have observed transitions to the highly excited states of the $^{23}Na^{39}K$ molecule by choosing the $B^1\Pi$ state as an intermediate state, the stepwise excitation

$$\Lambda(v, J) \leftarrow B^1\Pi(v', J') \leftarrow X^1\Sigma^+(v'', J'')$$

could be observed in the energy regions of 31250 - 31790 cm^{-1} and 33020 - 33670 cm^{-1}. Several $^1\Sigma^+$, $^1\Pi$, and $^1\Delta$ states are identified and the molecular constants were determined.

Many lines were found to deviate from the extrapolated values, and numerous anomalies of line intensities were observed in the OODR polarization spectrum. These irregularities are identified as originating from the perturbation between closely lying electronic states. Several types of the perturbation are found and analyzed.

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