A COMPACT CW-THz PHOTOMIXING SPECTROMETER : HCN LINES STRENGTHS AND BROADENING COEFFICIENTS AT FREQUENCIES UP TO 3.26 THz

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A continuous-wave THz spectrometer has been constructed using a photomixing source to provide a spectral resolution of 3 MHz (0.0001 cm^{-1}) at all frequencies from 300 GHz to 3.3 THz (10 cm^{-1} to 110 cm^{-1}). The source is composed of two extended cavity diode lasers, a tapered semiconductor optical amplifier and a photomixer element. The fine spectral resolution of this instrument is particularly suited to the analysis of molecules in the gas phase. In addition, the high species discrimination of the THz waveband promises much potential for the simultaneous detection of multiple industrial pollutants such as HCN, H_2S, H_2CO and C_2H_3Cl. The quantification of species requires reliable knowledge of transition line strengths and broadening coefficients.
In this context the absorption profile of HCN has been measured in the presence of oxygen and nitrogen as gaseous perturbers for pressures up to 35 mbar. Rotational J←J+1 transitions in the ground (0,0,0) state from 531 GHz to 3.26 THz (J=5 to J=36) were observed along with the upper degenerated $(0,1\frac{1}{2},0)$ bending state from 712 to 1246 GHz (J=7 to J=13). The broadening coefficients show little difference between the fundamental and excited transitions hence no vibrational dependence is observed. The availability of oxygen and nitrogen broadening coefficients allows a comparison to be made with the air broadening coefficient contained in the HITRAN database and shows a significant difference for transitions J$\geq$29. This demonstrates the attractiveness of this technique to provide spectral information at frequencies from 2 to 3 THz where commercial interferometers and electronic sources are not a viable alternative.