Abstract

Title: Spectrometric methods for detection and monitoring of ozone and atmospheric pollutants – laboratory studies and studies in simulated atmosphere.

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Abstract: The pollution of the atmosphere by numerous trace gases is of great importance due to its serious consequences to the human health and to the environment. High monochromatic infrared radiation of CO_2 laser is discretely tuneable in the range from 9,4 μm to 10,7 μm. In this range many significant atmospheric pollutants absorb. Relatively high power CO_2 laser enables monitoring these pollutants till trace concentrations. Laser diode spectroscopy using diode lasers as the source of IR radiation provides spectroscopic measurements with high spectral resolution on the level of Doppler broadening of absorption lines.

This thesis consists in development of the methods of concentration measurements with CO_2 laser photoacoustic spectroscopy. It includes determination of absorption coefficients, calibration constant, working with concentration standards etc. Further thesis deals with measurement of IR spectrum (ethanol, ozone) by laser diode and FTIR spectroscopy. We have studied absorption line broadening - pressure dependency. CO_2 laser photoacoustic detection is applied for measurement in the wind tunnel, where the model of city Hannover is used. Our interest was in detection of concentrations under several different speeds of air flow inside tunnel.

The lowest limit of detection (0,01 ppm) was obtained for ozone on 9P14 spectral line of CO_2 laser, ethanol was measured on line 9P14 and 9R30. Pressure broadening of absorption lines and corresponding detection on CO_2 emission line have been demonstrated for ozone. In wind tunnel CO_2 laser photoacoustic spectrometry has been applied for model of Hannover.

Keywords: photoacoustic detection, CO_2 laser, diode laser, aerodynamic tunnel, absorption IR spectrum, ozone.