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BOOKLET

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New Trends and Challenges for Air Quality Control

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OPTICAL AIR QUALITY SENSORS: BENZENE, DUST, CO_2

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Benzene detection

Benzene detection is a challenging because benzene is already toxic at low concentrations and permitted limit is 1 ppm ~ 3 µl/m^3. Benzene is used in gasoline and solvents as well as it is emitted with smoke. We explore possibility to detect benzene in air using UV absorption spectroscopy and mercury emission line at 254 nm. Benzene spectrum has absorption feature at 254 nm. We recently demonstrated [1] that it is possible to use a commercial portable Zeeman atomic absorption mercury spectrometer *Lumex RA 915+* for measuring benzene in air, see Fig.1.

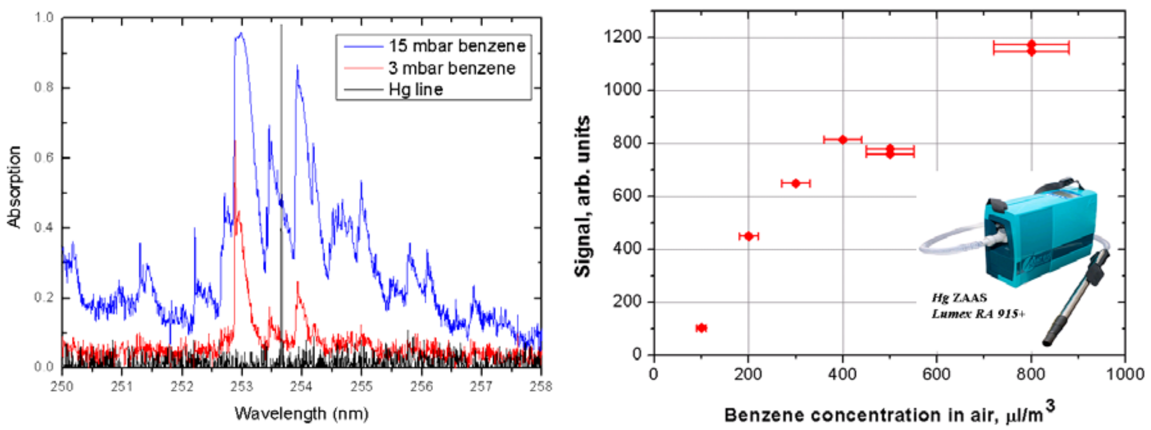

Figure 1. Left: Recorded UV absorption spectra of benzene vapour and atomic emission line from mercury. Right: Measuring benzene in air with a commercial mercury Zeeman atomic absorption spectrometer.

NDIR CO2 sensor

CO2 is a greenhouse gas and it's concentration has been increasing during last 50 years of monitoring from 300 to 400 ppm. CO_2 content in exhaled air is about 100 times larger 4%. Elevated CO2 concentrations in air are responsible for tiredness and is a problem in many school and university lecture halls. CO_2 sensor could help to save energy by optimizing automatic ventilation. We have compared electrochemical CO_2 sensor *MQ135* with a commercial non-dispersive infrared (NDIR) [2] CO_2 sensor *Extech CO100*. Electrochemical sensor needs long warm-up time and is influenced by ambient temperature changes. NDIR CO2 analyser is more precise, specified uncertainty is 75 ppm. Using a Wi-Fi adapter board *ESP8266* we have connected the *Extech CO100* sensor to Internet cloud service *Xively.com* for storage and live graphing of data, see Fig. 2.

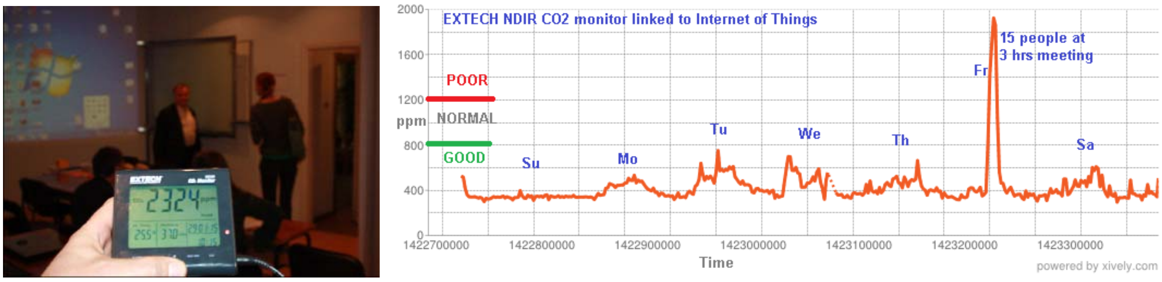

Figure 2. Left: NDIR CO2 monitor *Extech CO100*. Right: One week of monitoring CO2 level in office and during a meeting.

Dust sensor

We have constructed airborne dust sensor based on 1 W blue 455 nm diode laser and a photodetector allowing to count light flashes scattered by dust. In the city air we count up to 50 particles/cm^3 (50 million/m^3). Our design is similar to [3] but by using a blue laser we are more sensitive to small dust. We needed to monitor air in the laser laboratory, where dust causes decrease of laser power. Fine dust originates from car tires, diesel engines, heating chimneys, pollen, construction, etc. Particles in the range 1 - 10 μm can penetrate deep into lung alveoli and can cause asthma and lung cancer. We have installed air filter and see that consumer grade filter stops 90 % of dust by mass, but only roughly 1 % by count and the fine dust can be stopped only using HEPA grade air filters.

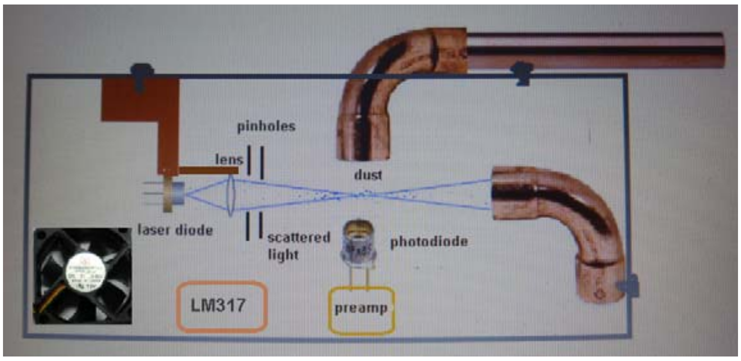

Figure 3. Home-made laser-based airborne dust sensor.

References

1. J. Alnis, G. Revalde, A.Vrublevskis, Z. Gavare, “Optical diagnostic method for benzene detection in air”, Proc. of SPIE, **9421** (2014) 94210E-6.
2. J. M. Feldman, "Infrared Measurement of Carbon Dioxide in the Human Breath: “Breathe-Through” Devices from Tyndall to the Present Day", Anesthesia and Analgesia, **107**, (2008) 890-904.
3. A. Morpurgo, F. Pedersini, A. Reina, "A low-cost instrument for environmental particulate analysis based on optical scattering," Instrumentation and Measurement Technology Conference (I2MTC) 13-16 May, IEEE International, (2012) 2646-2650.

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