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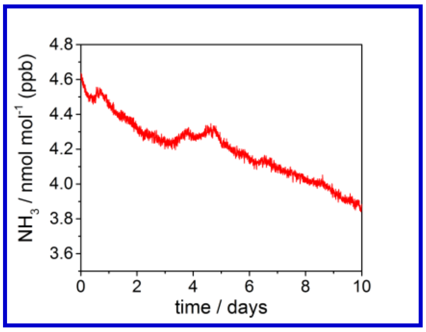

Results from trace ammonia concentration measurements in ambient air, performed in PTB's clean room

Contacts:

Dr. Olav Werhahn
Dr. Nils Lüttschwager,
Physikalisch-Technische Bundesanstalt
Working Group 3.22,
Metrology in Molecular Spectroscopy
DE-38116 Braunschweig
Phone +49 531 592 3123
E-Mail: nils.luettschwager@ptb.de, olav.werhahn@ptb.de

Dr. Kaj Nyholm (project coordinator)
VTT MIKES, Tekniikantie 1, P.O. Box 9,
FI-02151 Espoo
Phone +358 505 110 058
E-Mail: kaj.nyholm@VTT.fi

Partners and Associates:

VTT MIKES, Finland (Coordination)
CMI, Czech Republic
INRIM, Italy
NPL, United Kingdom
PTB, Germany
VSL, the Netherlands
HC Photonics Corporation, Taiwan

Online airborne molecular contamination measurement techniques based on optical detection

Measurement of airborne molecular contamination (AMC) has become a prerequisite for nano-scale manufacturing processes in clean rooms and facilitates higher product yields and quality. In the framework of the EMRP project MetAMC, PTB developed and tested optical methods for AMC detection. These techniques are easy to implement and to operate in the clean room and enable real-time monitoring of air quality.

Technical description

Laser absorption spectroscopy is a powerful tool to quantify the concentration of pollutants in air at trace levels. Techniques like cavity ring-down spectroscopy (CRDS) and photoacoustic spectroscopy (PAS) have reached technical maturity and are now widely commercially available. These techniques use the fact that light absorption by pollutants is highly compound-specific and provides excellent chemical selectivity with low probability of false alarm. The use of optical resonators in CRDS or sensitive microphones in PAS enables detection limits down to levels which are relevant for AMC monitoring in clean rooms, e.g. <1 ppb for ammonia.

While commercial spectrometers are often turn-key devices which can be operated without a high level of training, a deeper understanding of the technology is useful to harness the full potential of spectroscopic gas analysis. For example, some CRDS spectrometers may be operated without the need of calibration gas by data evaluation based on tabulated molecular parameters, using special protocols developed at PTB, or cross-interferences may be identified by custom spectral evaluation.

Through the expertise accumulated in the course of the MetAMC project, PTB can now offer guidance for industrial partners who seek to employ absolute optical detection of AMC in their clean room facilities.

Advantages of optical AMC detection

- Turn-key, autonomous operation with relatively low operational costs
- Real-time measurement
- Low detection limit and high dynamic range
- Measurement uncertainties in the low percent range
- Traceability through reference gas mixtures or traceable molecular parameters

Economic significance

AMC affect the product yield and inhibit the advance to smaller scale manufacturing techniques. The effective implementation of AMC monitoring equipment can enable more cost efficient fabrication and fabrication of new, innovative products and thus increase the overall competitiveness.

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