Characterisation of impurities in NO_2 reference gas mixtures using FTIR spectroscopy

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Nitrogen dioxide (NO_2) is a reactive gas that contributes to acid precipitation and modifies the oxidation capacity of the atmosphere. Furthermore, current ambient air concentrations of NO_2 negatively affects human health, especially in urban locations. In order to promote effective policies to mitigate the impact of NO_2 on air quality, ecosystems and human health, a highly accurate monitoring infrastructure - including selective laser spectroscopy and accurate stable reference gas mixtures - is required.

One of the objectives of the project 'Metrology for Nitrogen Dioxide' (MetNO$_2$) of the European Metrology Programme for Innovation and Research (EMPIR) is to provide accurate stable NO_2 reference gas mixtures. Full characterisation and minimisation of impurities in the reference gas mixtures will contribute to this objective.

In the framework of the project MetNO$_2$, we investigated the presence of the major impurity in NO_2 reference gas mixtures (i.e. nitric acid, HNO_3). We generated dynamically HNO_3 and NO_2 gas mixtures by the permeation method using a magnetic suspension balance. We coupled a Fourier transform infrared (FTIR) spectroscope to the magnetic suspension balance to analyse the generated gas mixtures. The collected spectra of the HNO_3 reference will be used to quantify the molar fraction of HNO_3 in NO_2 reference gas mixtures. Here, we present preliminary results of the HNO_3 characterisation together with the corresponding uncertainties.

The impurity characterisation will provide a better understanding of the reactions taking place in NO_2 reference gas mixtures. This characterisation will also allow optimising the operational conditions needed to minimise the formation of impurities. Thereby, more accurate and stable NO_2 reference gas mixtures will be delivered to fulfil the requirements of the monitoring community.