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Investigation of adsorption / desorption behavior of various materials in small volume measurement chambers and its relevance to atmospheric trace gas analysis

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A critical issue for the long term monitoring of atmospheric trace gases is precision and accuracy of the measurement systems employed. To ensure the best preparation and measurement conditions for trace gases in very low concentrations, usage of coated materials are in demand in gas metrology and atmospheric measurement communities. Such coatings may provide inert, corrosion resistant, or hydrophobic surfaces, and enable usage of metals instead of polymers with ambiguous outgassing effects. This study focuses on testing of different materials or coatings which are currently used or may be relevant in future for the measurements of greenhouse gases.

For this study, we use the previously tested high pressure small volume cylinders, which were constructed such that they can serve as adsorption test chambers. Various materials with or without coatings are loaded into the small cylinder to test their adsorption / desorption behavior. In this study, we use the aluminum cylinder as the measurement chamber, and glass, aluminum, copper, brass, steel and its three different commercially available coatings as the test materials. Through inserting the test materials, the available geometric area for the surface processes is doubled. The presented experiments are designed to investigate the pressure dependency until 20 bars, and temperature dependency up until 80˚C for the test materials placed in the measurement chamber. Here, we focus on the species CO_2, CH_4, CO and H_2O measured by a cavity ring down spectroscopy analyzer. To our knowledge, this study is one of the first attempts to quantify surface effects of different materials in such a setup for the above mentioned gases.