The *airbubbl*, a portable air cleaner, efficiently removes formaldehyde and other pollutants from vehicle cabins. Picarro's Cavity Ring-Down spectrometer enables **monitoring formaldehyde** removal continuously **at the ppt level**.

Monitoring the efficiency of a portable air cleaner for formaldehyde removal with a Cavity Ring-Down Spectrometer

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INTRODUCTION

- The air quality inside vehicles is affected by the intake of polluted air and by outgassing of fabrics.
- Airlabs developed a portable air cleaner, the *airbubbl*, to remove particulate matter, NO_2 and other pollutants from air. A new filter was designed to also remove formaldehyde.
- Here, we present the performance of the new formaldehyde filter, also in comparison to a range of different adsorbents and catalysts.
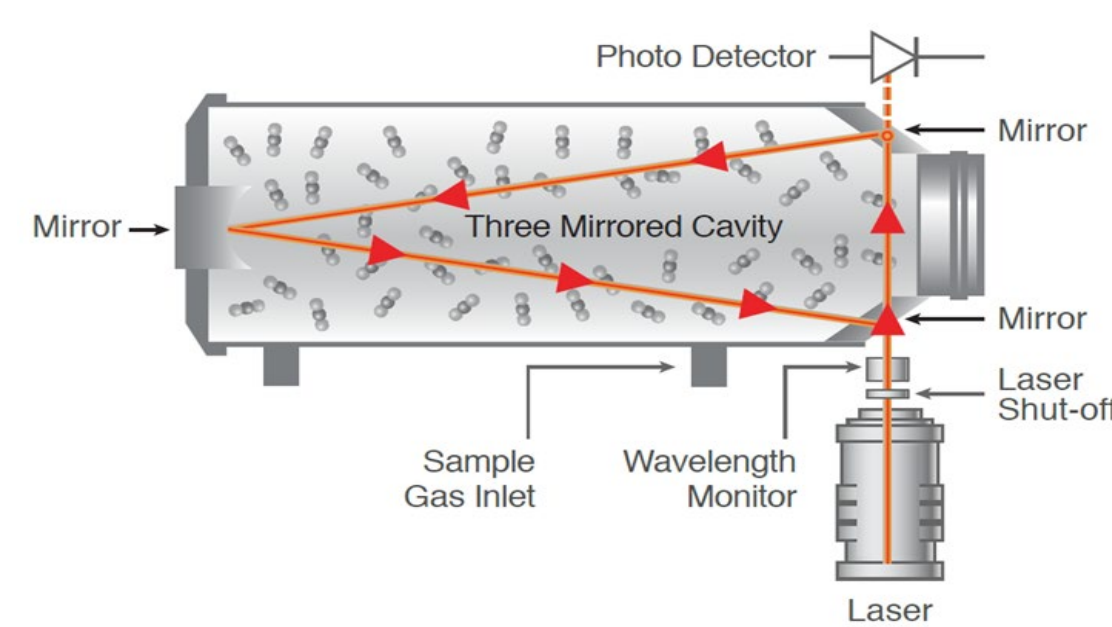
INSTRUMENTATION

CRDS Technology and Picarro G2307 Analyzer

Cavity Ring-Down Spectroscopy (CRDS) Technology utilizes the unique infrared absorption spectrum of gas-phase molecules to continuously measure the concentration of trace gases, like formaldehyde (CH_2O).

G2307 Features:
- Direct measurement, no wet chemistry for continuous and in-situ analysis
- ppt level of precision for $[CH_2O]$
- High stability for low calibration frequency
- Instrument validation with CH_4 as surrogate gas
- SilcoNert coated cavity and Teflon coated sample handling

G2307 Performance Specifications:

G2307 Performance Specifications	H₂CO	CH₄	H₂O
Lower Detection Limit (3σ, 300 sec)	0.3 ppb	6 ppb	-
Zero Drift (24 hrs) *(peak-to-peak, 50-minute average)*	1.5 ppb	-	-
Precision (1σ, 2 sec) Precision (1σ, 10 sec) Precision (1σ, 300 sec)	1.2 ppb + 0.1% of reading 0.6 ppb + 0.05% of reading 0.1 ppb + 0.02% of reading	20 ppb + 0.2% of reading 10 ppb + 0.1% of reading 2 ppb + 0.05% of reading	10 ppm + 0.1% of reading - -
Measurement Interval	<2 sec	-	-
Accuracy	±10%	±2%	±5%
Response Time (0-20 ppb)	Fall time 90–10% : <1min Rise time 10–90% : <1 min	-	-
Measurement Range	0-30 ppm	0-20 ppm	0-3%

METHOD

Two experimental setups were used in the study: A 1 m^3 chamber for chamber removal tests (see Fig. 1) and a column for single-pass removal measurements (see Fig. 2). The experiments were designed to mimic realistic environmental conditions for a filter used in an air cleaner targeting ambient air pollution.

MATERIALS

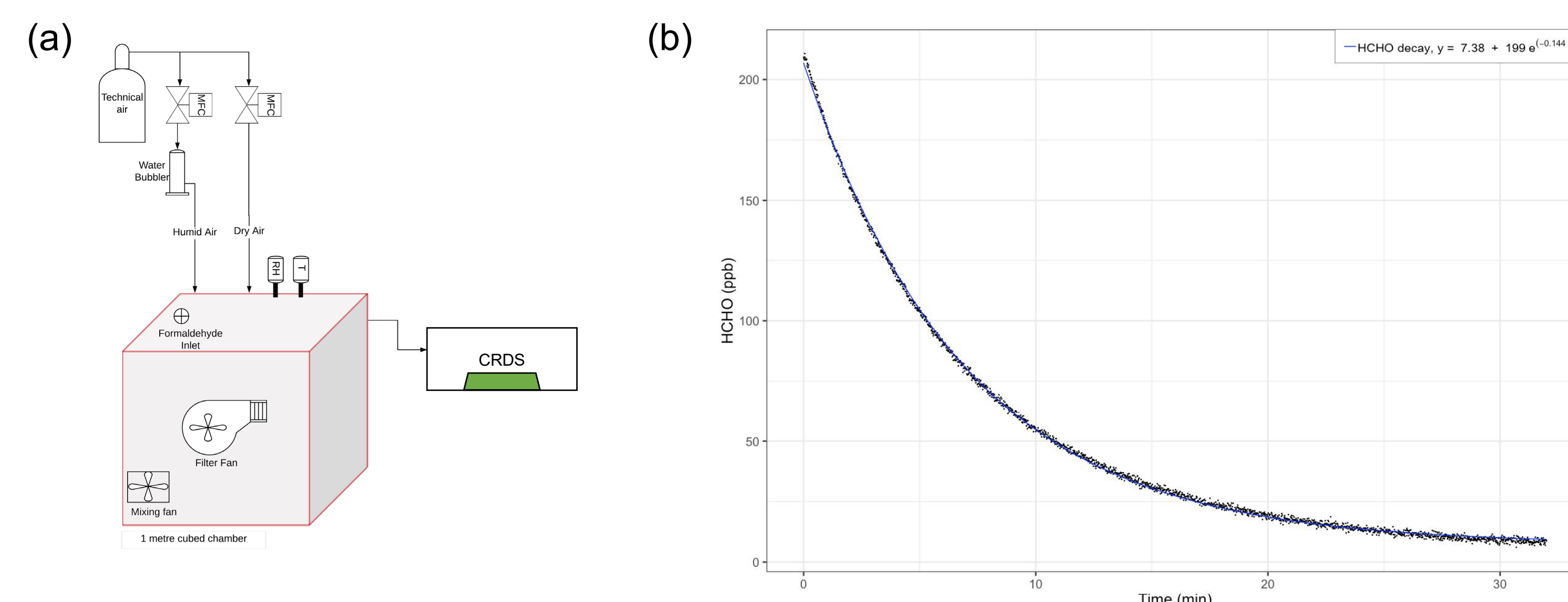| Abbreviated Name	Material Description
CAC	AC beads
IAC_2	CAC beads treated with para-aminobenzoic acid
CCF_1	Treated AC granules mounted on a HEPA style filter
CCF_2	Treated AC granules mounted on a HEPA style filter
AC_COMP_1	Treated AC pellets
AC_COMP_2	AC composite material
CIF_1	Treated AC beads mounted on to polymer foam
CIF_2	CAC beads treated with AL method
M_CAT_4	Metal oxide catalyst based on MnO_2
CAT_2	Gold nanoparticle catalyst with a TiO_2 support

RESULTS

Fig. 1: (a) Chamber test setup. (b) Formaldehyde removal by an *airbubbl* containing a cartridge consisting of an inner layer of 2 cm Airlabs ENC filter combined with an outer layer of 1 cm M_CAT_4 formaldehyde removal catalyst, tested at 35% relative humidity.
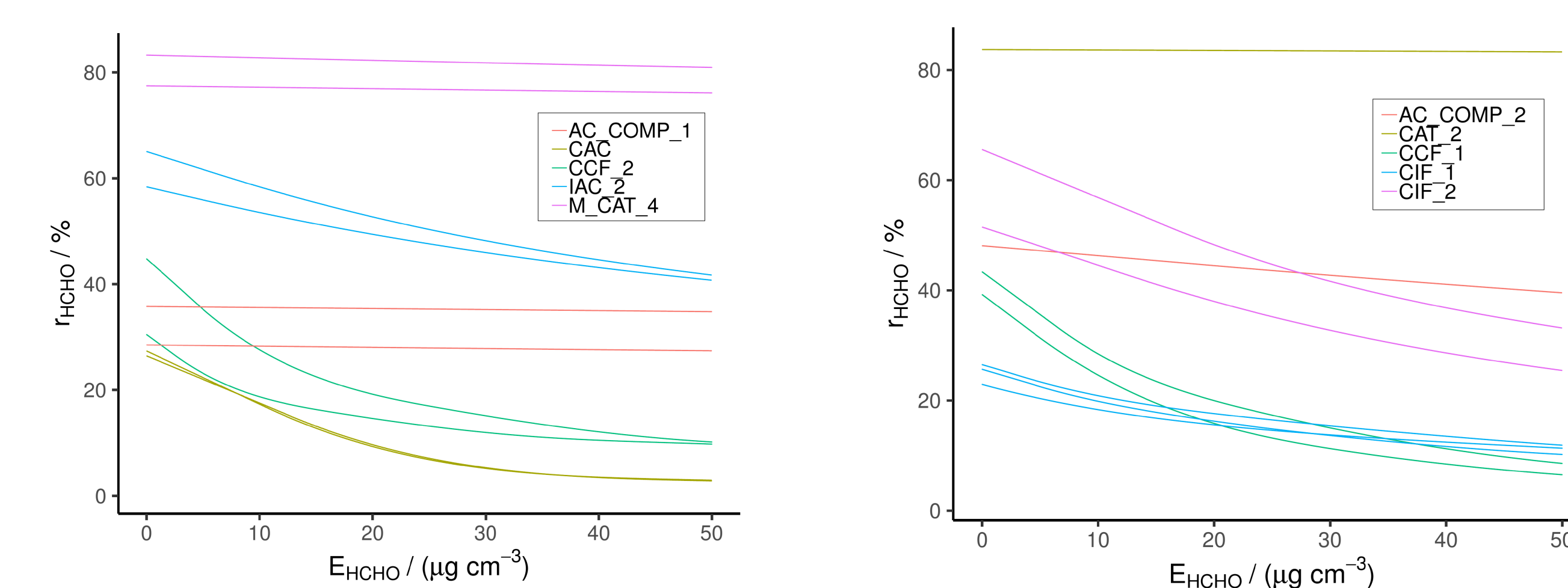

Fig. 2: Removal efficiency for formaldehyde in percent as a function of cumulative exposure, per volume of filter material. Tests were conducted at a relative humidity of $50\pm2\%$ and inlet $[H_2CO]$ of 160 ± 10ppb, with 0.4g of material. Experiments were performed in a capacity test setup.

CONCLUSIONS

- The high time resolution and response time of the Picarro G2307 gas analyzer allowed easy testing of the different filter materials under various conditions.
- The gold nanoparticle catalyst (CAT_2) showed the highest performance for formaldehyde removal.

Interested in learning more?
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- Visit www.picarro.com and www.airbubbl.com

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