Supporting information for:

Preparation of low concentration H_2 test gas mixtures in ambient air for calibration of H_2 sensors.

Niklas Karbach[1], Lisa Höhler[1], Peter Hoor[2], Heiko Bozem[2], Nicole Bobrowski[3,4], Thorsten Hoffmann[1*]

[1] Department of Chemistry, Johannes Gutenberg-University Mainz, 55128 Mainz, Germany
[2] Institute for Atmospheric Physics, Johannes Gutenberg-University Mainz, 55128 Mainz, Germany
[3] Institute of Environmental Physics, University of Heidelberg, 69120 Heidelberg, Germany
[4] Istituto Nazionale di Geofisica e Vulcanologia (INGV), Osservatorio Etneo, 95125 Catania, Italy

Correspondence to: t.hoffmann@uni-mainz.de

S1:

To show the repeatability and stability of the setup, another experiment has been conducted, in which a new cathode and fresh electrolyte have been used. After an initial run-in phase of about 2 hours, that is not shown in this Fig. 1, the current yield approaches 1.0, showing the excellent predictability of the hydrogen output of the system.

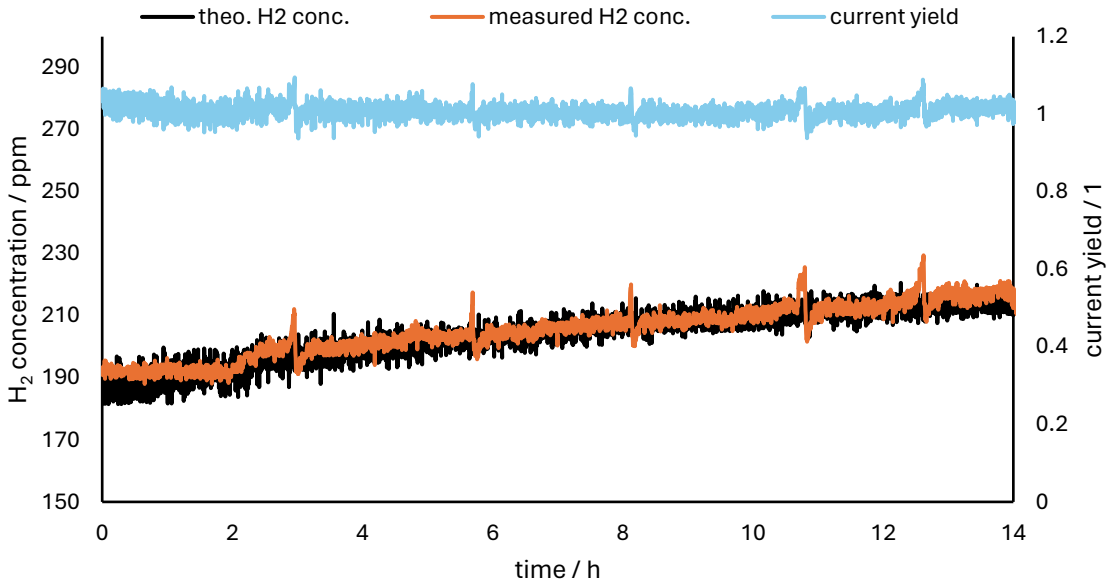

Figure 1: Diagram of a long-term experiment that was set up with a new cathode and new electrolyte. Although the current slowly increases over the duration of the experiment, the current yield stays consistently at 1.0 showing that the expected output (by measuring the electric current flowing through the cell) exactly matches the measured output.

S2:

Accuracy of the standard obtained & Faraday´s first law of electrolysis:

The accuracy of the standard that is obtained is directly proportional to the current yield of the reaction, that is shown in the diagrams. A current yield of 1.00 means that the measured concentration is the same concentration as is predicted by applying Faraday´s first law of electrolysis and incorporating the dilution with ambient air (500 mL/min in our experiments). The current yield η_c calculates according to the following formula:

$$\eta_c = \frac{c_{\text{measured}}}{c_{\text{theoretical}}}$$

A current yield of 1.00 therefore results in a totally accurate standard.

The theoretical amount of hydrogen *n* produced in a certain amount of time *t* can in turn be calculated with Faraday´s first law of electrolysis with the electric current *I*, the number of electrons used in the reaction *z* and the Faraday constant *F*.

$$n_{\text{Product}} = \frac{It}{zF}$$

The theoretical amount of hydrogen that is produced per minute, combined with the dilution flowrate gives the theoretical concentration of the resulting gas mixture. This theoretical concentration is then compared to the actual measured concentration to obtain the current yield of the system.