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Supporting Information

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Opposite signs of capacitive microsensor signals upon exposure to the enantiomers of methyl propionates

Petra Kurzawski[1], Anja Bogdanski[2], Volker Schurig[2], Reinhard Wimmer[3], & Andreas Hierlemann[1]

[1] Physical Electronics Laboratory, ETH Zürich, CH-8093 Zürich, Switzerland

[2] Institute of Organic Chemistry, University of Tübingen, D-72076, Tübingen, Germany

[3] Department of Life Sciences, Aalborg University, DK-9000, Aalborg, Denmark

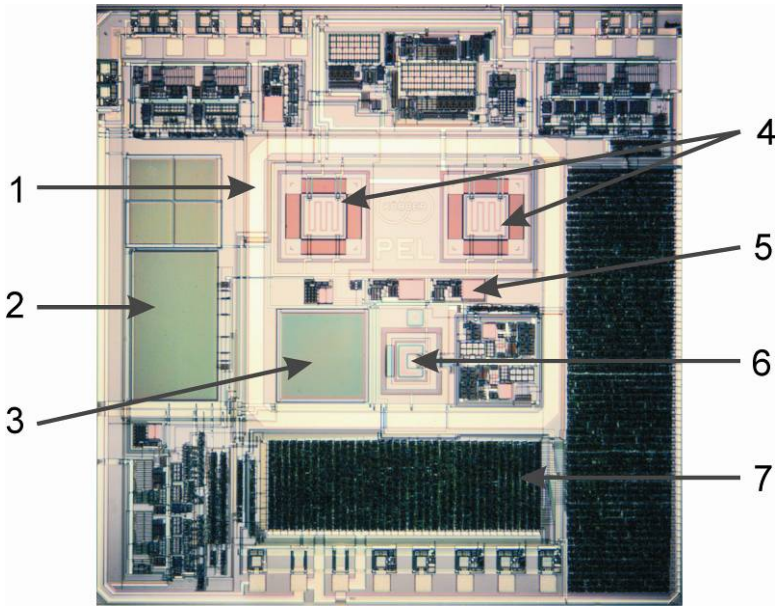

Fig. S-1 **Micrograph of the used gas microsensor system chip** (details in Hagleitner et al., *Nature* 414, 293, 2001)**, which includes three different transducers (capacitive, mass-sensitive, calorimetric), which are used and measured simultaneously (chip size 7x7 mm^2).** In this publication only the capacitive results are discussed, but all other transducer data are also available and have been used for data interpretation. The different microsystem components include: (**1**) Flip-chip frame. (**2**) Reference capacitor. (**3**) Sensing capacitor. (**4**) Calorimetric sensor and reference. (**5**) Temperature sensor. (**6**) Mass-sensitive resonant cantilever. (**7**) Digital interface. The chip was previously presented for the detection of volatile organic compounds.

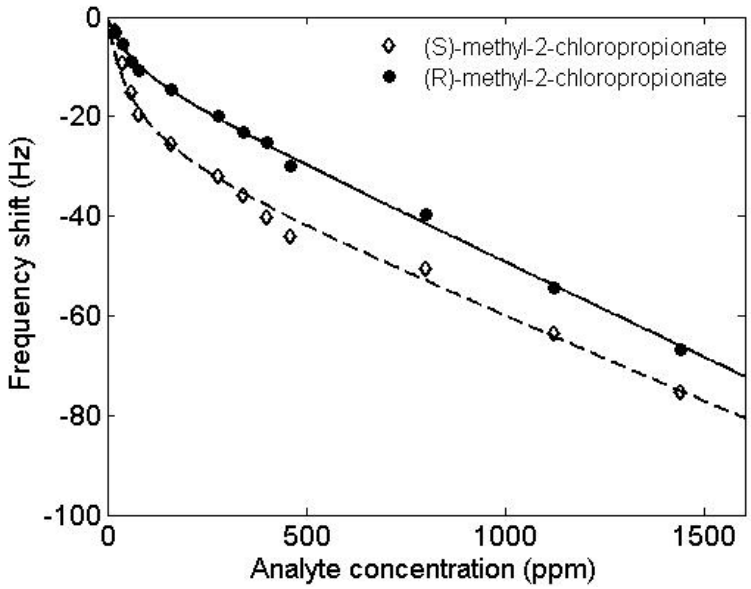

Fig. S-2 **Measurement results of the mass-sensitive cantilever simultaneously recorded with the capacitive signals: Frequency shift versus enantiomer concentration for (S)- and (R)-methyl lactate.** This is a typical sensor results as also published for TSMRs in Ref. [1]: The signal amplitude upon exposure to the two enantiomers is different: (S) produces larger signal than (R), but the signal signs are the same.

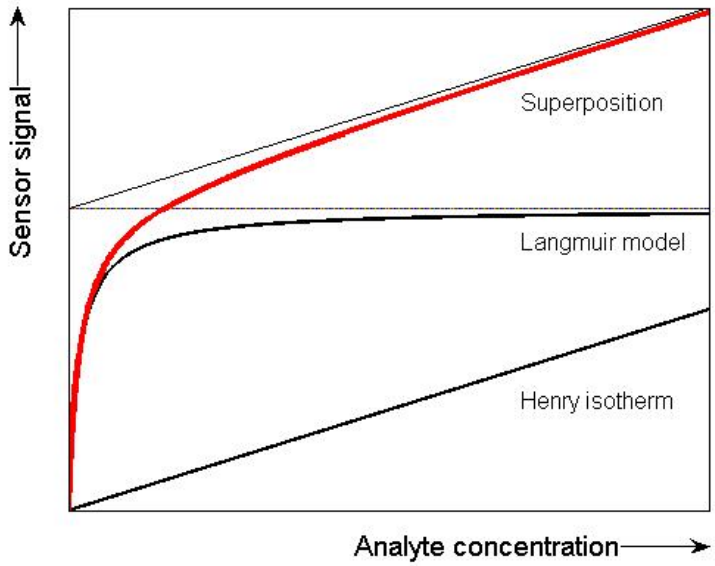

Fig. S-3 **Sensor signal versus enantiomer concentration as modelled based on thermodynamic considerations (details in** K. Bodenhöfer, et al., *Analytical Chemistry* **69** (19), 4017, 1997)**..** At low analyte concentrations the sorption can be described as Langmuirian-type, with increasing concentration and after full occupation of the cyclodextrin receptor, the linear Henry-type sorption is predominant. The resulting sensor signal is a superposition of both sorption isotherms.

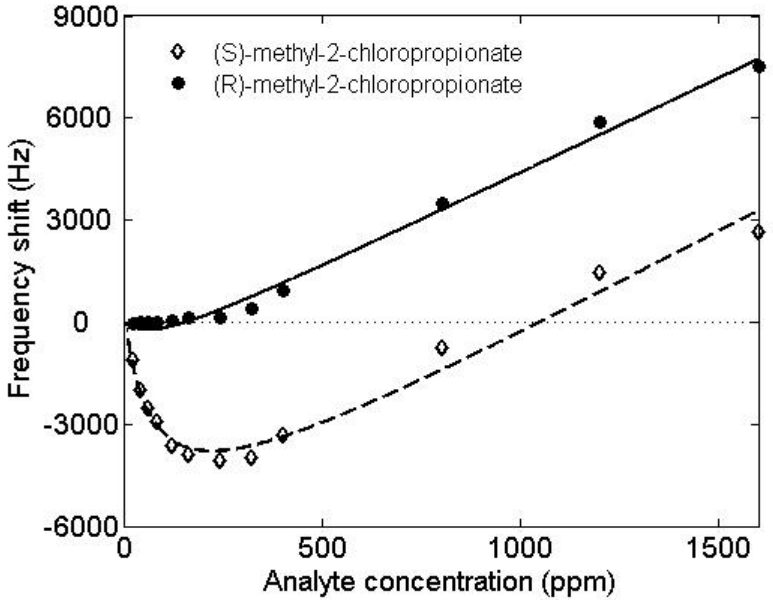

Figure S-4 **Capacitive sensor signals of a β-cyclodextrin versus enantiomer concentration upon the dosage of (S)- and (R)-methyl lactate.** The enantioselective coating is a mixture of PDMS and heptakis(3-O-butanoyl-2,6-di-O-pentyl)-β-cyclodextrin at 50% (w/w). The results are similar to those achieved with the γ-cyclodextrin.

Results of NMR titration

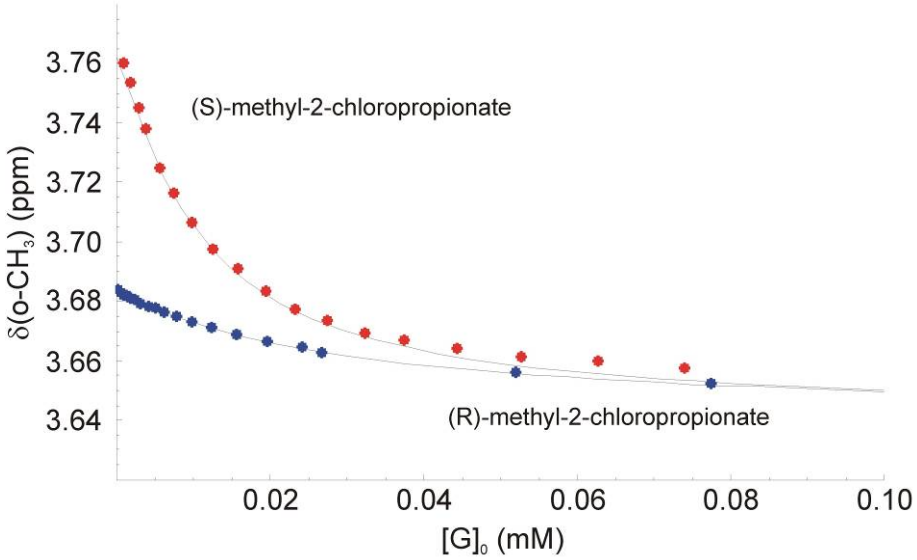

Fig. S-5 **Chemical shift of the O-Me group of (R)- and (S)-methyl-2-chloropropionate versus their concentration in the presence of 3.6 mM octakis(3-*O*-butanoyl-2,6-di-*O*-*n*-pentyl)-γ-cyclodextrin in cyclohexane-d_{12}.** The data points are depicted as solid dots, the lines present the fits.

Results of NOESY NMR

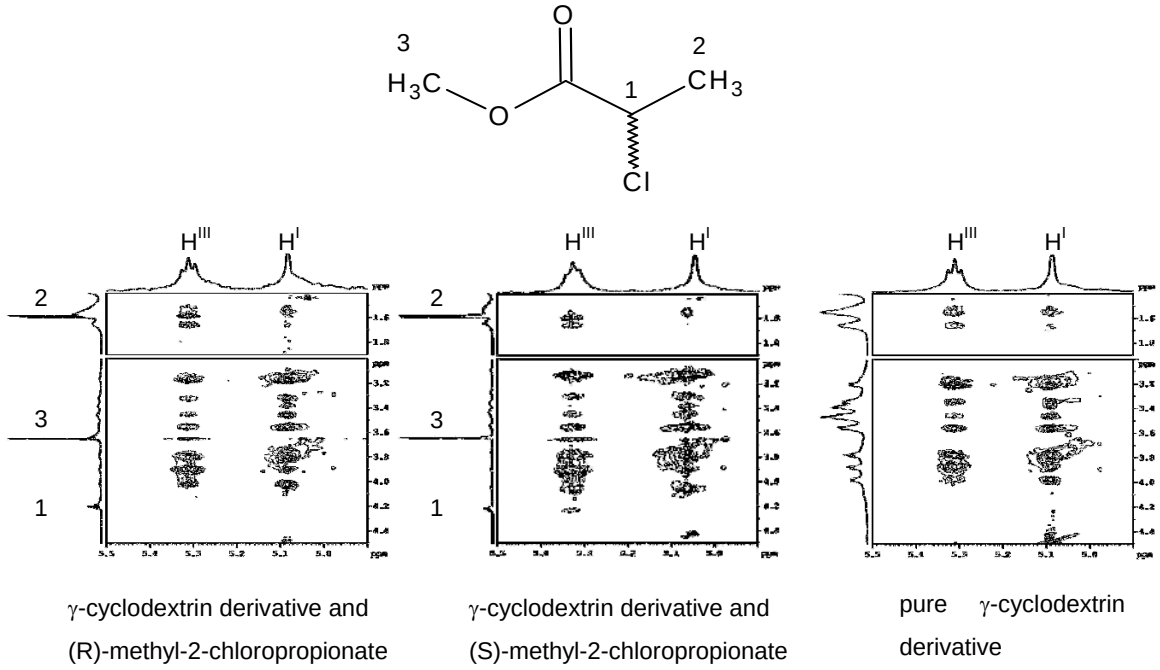

Fig. S-6 Regions of interest of a 2D-NOESY spectrum. The mixing time of (R)- (left panel) and (S)-methyl-2-chloropropionate (central panel) with octakis(3-*O*-butanoyl-2,6-di-*O*-*n*-pentyl)-γ-cyclodextrin was 250 ms. The right panel shows an identical 2D-NOESY spectrum of the pure γ-cyclodextrin derivative in the absence of any analyte. The Roman numerals denote the γ-cyclodextrin derivative resonances, while the Arabic numerals denote the resonances of each enantiomer.

NMR Experimental details:

NMR: All NMR spectra were recorded on a BRUKER DRX600 NMR spectrometer operating at a field strength of 14.1 T, equipped with a triple-axis gradient TXI (H/C/N) probe.

Assignment: The resonances of the cyclodextrin derivative were assigned by help of a 2QF-COSY spectrum, the resonance assignment of methyl-2-chloropropionate is trivial.

Determination of stability constants: A sample of 4mM of Lipodex E in cyclohexane-d_{12} was titrated with small aliquots of a solution of 1 M methyl-2-chloropropionate. The chemical shifts of the methyl-2-chloropropionate resonances ($\Delta\delta_{obs}$) were plotted against the concentration. K_a was determined by fitting the following equation to the experimental data with the nonlinear regression module of Mathematica 3.0.

$$\Delta\delta_{obs} = \left(\Delta\delta_{bound} / 2[H]_0\right)$$
$$\left[\left\{[G]_0 + [H]_0 + K_a^{-1}\right\} - \left\{\left([G]_0 - [H]_0\right)^2 + \left(2[H]_0\right)^2 + \left(2[H]_0 / K_a\right) + \left(2[G]_0 / K_a\right) + K_a^{-2}\right\}^{1/2}\right]$$

where $\Delta\delta_{bound}$ is the chemical shift difference between free and bound methyl-2-chloropropionate (fitted simultaneously), $[G]_0$ is the total concentration of methyl-2-chloropropionate, $[H]_0$ is the total concentration of Lipodex E and K_a is the association constant of the complex formation.

NOE measurements: The samples after ended titration were used to record NOESY spectra. The final sample concentrations were: 3.64 mM Lipodex E and 74 mM (S)-methyl-2-chloropropionate and 3.60 mM Lipodex E and 77.6 mM (R)-methyl-2-chloropropionate,

respectively, in cyclohexane-d_{12}. 2D-NOESY spectra were recorded at 35°C with a mixing time of 250 ms, and a spectral resolution of 0.95 Hz/pt in the direct dimension and 3.80 Hz/Pt in the indirect dimension.

Sensor preparation and gas test measurement details:

The adsorptive films consisted of a cyclodextrin derivative diluted in a polysiloxane matrix, which previously has been applied to enantioseparation in capillary gas chromatography. The chosen γ-cyclodextrin derivative (CD) was octakis(3-*O*-butanoyl-2,6-di-*O*-n-pentyl)-γ-cyclodextrin. The matrix was a poly(dimethylsiloxane), Silicone GE SE-30, which is commercially available from Supelco, Bellefonte, PA, USA. Besides the pure compounds (CD, SE-30) mixtures with 50% weight/weight cyclodextrin content were used in this study. For coating the devices, the polymers (or polymer solutions) were dissolved in dichloro-methane (concentrations ~1 mg/mL). The solutions were sprayed onto the cleaned devices with an airbrush using pure nitrogen as a carrier gas.

For gas tests, the CMOS chips were mounted on dual-in-line packages and then loaded into the measurement chamber of a computer-controlled gas manifold featuring a cross-over flow architecture (for extensive details on the setup, see Kummer et al. Anal. Chem. 2006, 78, 279-290). This cross-over flow architecture has two input gas lines, one supplying pure carrier gas and the other supplying carrier gas with defined doses of the volatile analyte, and two output gas lines, one leading to the measurement chamber, the other leading directly to the exhaust. This architecture offers the advantage that both input flows and both output flows are continuously flowing and the build-up time of a certain analyte concentration does not influence the dynamic sensor responses. The overall gas volume between the valve and the sensors was approximately 1.6 ml, which entails a time span of approx. 0.5 s after switching the valve until the gas reaches the sensors at the applied flow rate of 200 ml/min. The analyte vapors were generated from specifically developed temperature-controlled (T = 223 to 293 K) vaporizers using dry synthetic air as carrier gas and then diluted to known concentrations by computer-driven mass flow controllers. The internal volume of these vaporizers, which distribute the liquid over a large-area packed-bed type support to maximize surface-to-volume ratio, was dramatically smaller than that of typical gas-washing bottles ("bubblers"). For details, see Bodenhöfer et al. Sens. Actuators B 45/3 (1997) 259-264. The vapor-phase concentrations at the respective temperatures were calculated following the Antoine equation. The sensor measurements were performed in a thermo-regulated chamber at a temperature of 303 K. Both gas streams (pure carrier gas and carrier gas with analyte) were thermostabilized at the measurement chamber temperature before entering the chamber. The response time of the sensors at the given polymer thickness (2-3 µm) is on the order of a few seconds. Typical experiments consisted of alternating exposures to pure synthetic air and analyte-loaded synthetic air. Exposure times of 15-20 minutes to analyte-loaded gas (to reach thermodynamic equilibrium) were followed by 15-20 minutes purging the chamber with pure synthetic air. The sampling frequency of all sensors was 1.5 Hz.

The selected analytes included, on the one hand, standard organic solvents that were used as purchased from Fluka, Buchs, Switzerland without further purification (n-octane, toluene, methyl propionate etc.). On the other hand it included chiral analytes, i.e., both enantiomers of methyl lactate (purity: 98 %, Sigma Aldrich AG, Steinheim, Germany), and both enantiomers of methyl 2-chloropropionate (purity > 99%, Sigma Aldrich AG, Steinheim, Germany) as well as racemic mixtures (Sigma Aldrich AG, Steinheim, Germany).