Fraunhofer IPMS

Electrochemical Analytic Chip

Electrochemical analytic chip, version 6, encapsulated on a ceramic board for electrochemical measurements in liquids.

Service

The measurement of voltage and current is essential in electrochemical analysis for determining chemical compounds in solution and their concentrations. Electrodes made of gold or platinum, in combination with reference electrodes such as Ag/AgCl , are often used for this application. A typical disadvantage of conventional measurement setups is the need for at least 20 ml of analyte, which requires large electrodes. As a consequence, the electrodes can be expensive and have to be cleaned periodically with substantial effort. Additionally, contaminated electrodes might cause measurement errors, where the replacement of electrodes made of precious metals is costly and environmentally unfriendly. The analytic chips developed by IPMS can overcome these issues and are especially suited for potentiometry and voltammetry measurements. The chips, with an area of 5 x 5 mm^2, offer different electrode geometries, sizes, and materials for the working, counter, and reference electrodes. Precise electrode geometries and dimensions provide another advantage for electrochemical measurements. The chips with these electrodes are easy to handle and require only a very small amount of precious metal due to their resourceefficient fabrication. Analysis with the chips can be performed directly with a measuring adapter, or they can be bonded to a ceramic board. The size of the ceramic boards is 30 x 9.3 x 0.63 mm^3 and the boards have six contact pads, allowing for the use of up to two individual 3-electrode measuring cells on one chip. A sample size of one droplet (~20 µl) containing the analyte is sufficient. The setup is compatible with aqueous solutions (pH 2… pH 10), as well as with most organic solvents. Available electrode materials are platinum, gold, silver and copper, with thicknesses from 1 µm to 3 µm. Customized chips, sensors, electrode geometries, and electrode materials are possible, thereby covering a broad spectrum of applications.

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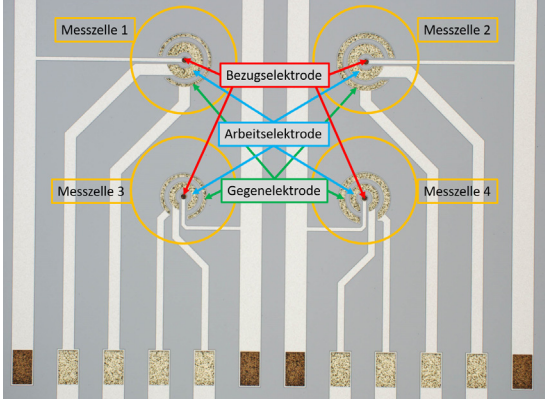
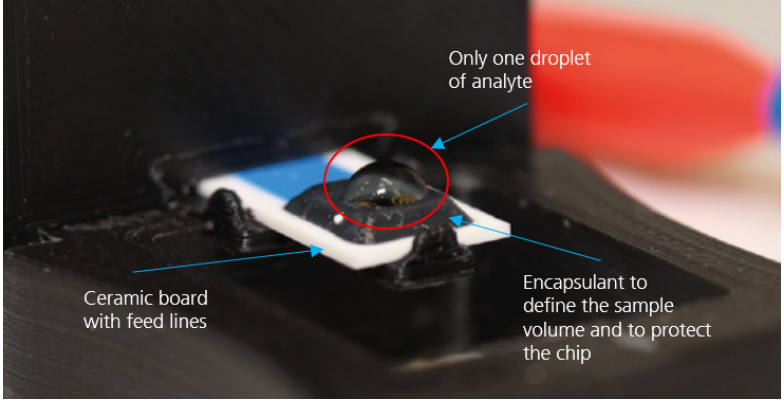
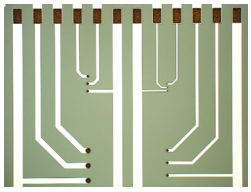


Close up of chip no. 6 with 4 different 3-electrode set ups

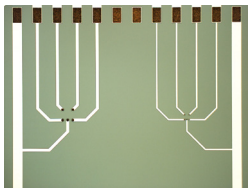


Chip module with one droplet of analyte in a measuring adapter.

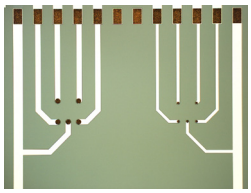
Available chip geometries and electrode sizes



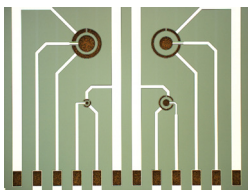
Electrode arrangement 1	Electrode geometry	Electrode distance
Messzelle 5 – 3x_D20 µm_50 µm	20 µm, rund	50 µm
Messzelle 6 – 3x_D50 µm_100 µm	50 µm, rund	100 µm
Messzelle 7 – 3x_D50 µm_200 µm	50 µm, rund	200 µm
Messzelle 8 – 3x_D100 µm_200 µm	100 µm, rund	200 µm



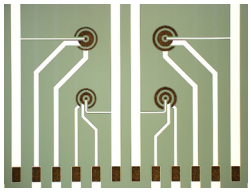
Electrode arrangement 2	Electrode geometry	Electrode distance
Messzelle 13 – 5x_D20 µm_80 µm	20 µm, rund	80 µm
Messzelle 14 – 5x_D50 µm_160 µm	50 µm, rund	160 µm



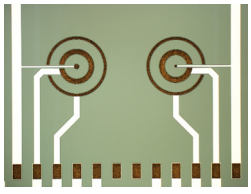
Electrode arrangement 3	Electrode geometry	Electrode distance
Messzelle 15 – 5x_D50 µm_320 µm	50 µm, rund	320 µm
Messzelle 16 – 5x_D100 µm_320 µm	100 µm, rund	320 µm



Electrode arrangement 4	Electrode geometry	Electrode distance	Real size µm²
Messzelle 17 – 3x_D60 µm_30 µm	60 µm, rund	30 µm	2800, 4300
Messzelle 18 – 3x_D130 µm_60 µm	130 µm, rund	60 µm	13000, 13000
Messzelle 19 – 3x_D330 µm_60 µm	330 µm, rund	60 µm	85500, 85500
Messzelle 20 – 3x_D260 µm_120 µm	260 µm, rund	120 µm	53000, 53000



Electrode arrangement 5	ID, d	Radius	Real size µm²
Messzelle 25 – WE-CE-RE	50 µm, 50 µm	75 µm, 125 µm, 175 µm, 202 µm	27000, 27000
Messzelle 26 – WE-CE-RE	50 µm, 50 µm	75 µm, 125 µm, 175 µm, 223 µm	27000, 54000
Messzelle 27 – WE-CE-RE	50 µm, 50 µm	75 µm, 159 µm, 209 µm, 232 µm	54000, 27000
Messzelle 28 – WE-CE-RE	50 µm, 50 µm	75 µm, 159 µm, 209 µm, 253 µm	54000, 54000



Electrode arrangement 6	ID, d	Radius	Real size µm²
Messzelle 29 – WE-CE-RE	100 µm, 200 µm	250 µm, 350 µm, 550 µm, 603 µm	180000, 180000
Messzelle 30 – WE-CE-RE	50 µm, 200 µm	225 µm, 333 µm, 533 µm, 588 µm	180000, 180000

*WE = Working electrode, CE = Counter electrode; RE = Reference electrode

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