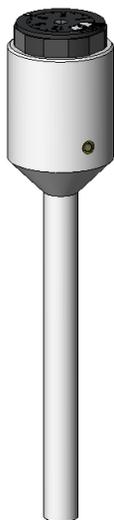




Hydrogen-Reference-Electrode

US Patent: 5 407 555



HydroFlex[®]

Manual

I. Introduction

The Standard Hydrogen Electrode (SHE), usually realised by a platinised platinum sheet in an acidic aqueous solution supplied with hydrogen gas, represents the reference point for electromotive forces.

By definition this potential has been fixed to 0 V in 1912. Therefore every electrochemical potential is referenced to the H₂ potential:



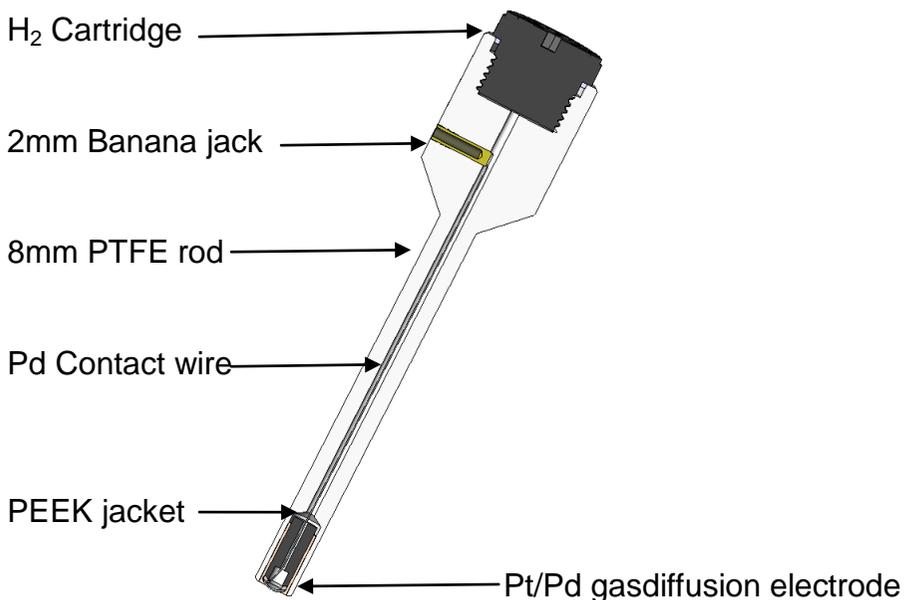
Even nowadays H₂-reference-electrodes are prepared by loading a platinized platinum sheet with a hydrogen flow coming from a pressure cylinder. Such an arrangement is huge, heavy and expensive and does not fit to the requirements of daily use in a lab.

The reference-electrode HydroFlex[®] is a handy alternative. HydroFlex[®] does not need an external hydrogen feed. A replaceable internal hydrogen cartridge generates hydrogen, which flows through a rod to a platinized gasdiffusion electrode. By immersing this gasdiffusion electrode into an electrolyte, the gasdiffusion electrode is partly filled with hydrogen while the other part is filled with the electrolyte.

Hydroflex[®] directly measures the activity of hydrogen ions.

II. Size and Used Material

HydroFlex[®] is as small as a pencil and thereby very handy. The total length is 12 cm only. The rod has a diameter of approx. 8 mm and is made of PTFE.



III. Measuring

HydroFlex[®] measures the electrochemical potential directly in organic and inorganic electrolytes¹.

HydroFlex[®] operates in the whole pH range.

HydroFlex[®] operates in fluorine containing electrolytes permanently, even at very high concentrations.

HydroFlex[®] operates in liquids with up to 210°C.

HydroFlex[®] may also be used with a salt bridge, for example to work as in Normal Hydrogen Electrode, or to prevent poisoning of the Pt catalyst.

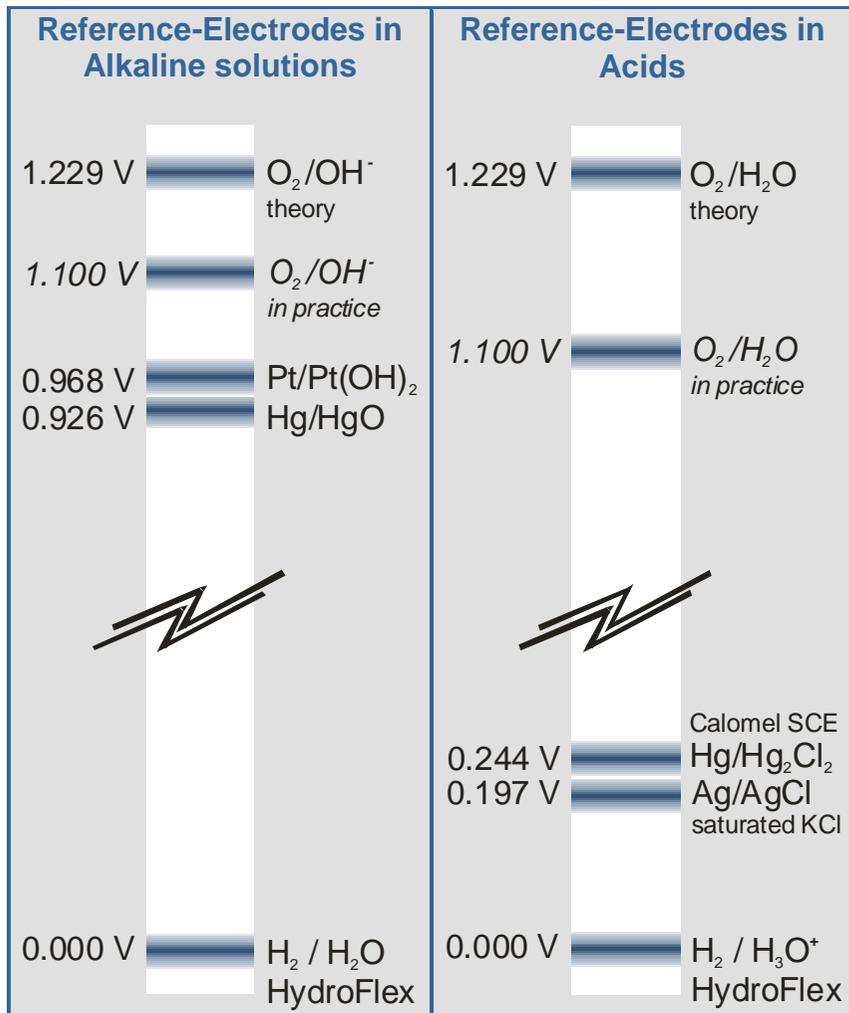
HydroFlex[®] requires a volt meter with only 5MΩ input impedance (or higher).

You will find more informations at

www.reference-electrode.info

¹ We have observed difficulties in Maleic acid, Nitric acid above 2m/l and Aqua Regia

IV. Potentials



V. Setup of the Electrode

	<p>Remove the protective cap from the gasdiffusion electrode</p>
 <p>24h</p>	<p>Adjust the operating time to 1 month with a 3mm hex screw driver. Put Hydroflex for 24h in a beaker with water</p>
	<p>Note the date of activation on the sticker.</p>
	<p>No adjust the operating time with a hex screwdriver (3mm) to a position between 1 and 12 month. A typical value would be 6 month operation; that means position 6.</p>

VI. Troubleshooting

Observation	Potential Cause	Corrective
Wrong potential	<ul style="list-style-type: none"> Poor contact 	<ul style="list-style-type: none"> ➤ Check test lead ➤ Check reference electrode
	<ul style="list-style-type: none"> Ion exchange slow. For example coming from concentrated, large ions into dilute solutions. 	<ul style="list-style-type: none"> ➤ Check potential in 1m HCl
	<ul style="list-style-type: none"> Potentially runtime of the cartridge is exceeded Cartridge empty 	<ul style="list-style-type: none"> ➤ Check lifetime of the cartridge ➤ Exchange the hydrogen cartridge (See Chapter X)
Deposit (i.e. red or grey) on the gasdiffusion electrode	<ul style="list-style-type: none"> Low hydrogen production Impurities in the electrolyte 	<ul style="list-style-type: none"> ➤ Rinse with suitable solvent ➤ Clean with distilled water

VII. Exchange of the Hydrogen cartridge

When the operating time has elapsed, the Hydrogen cartridge is exhausted.

Exceeding the runtime can lead to damage of the gas diffusion electrode and must be avoided.

With a 21 mm wrench you can remove the old cartridge and replace it by a new one. Be careful with the right position of the O-ring when replacing.

For functional safety the thread shall be sealed with general purpose grease.

VIII. General cleaning

Remove the cartridge.

Put the bottom of Hydroflex for 1h into a 1m HNO₃ solution.

Bring the whole Hydroflex into water for 24h.

Dry the Hydroflex at about 120°C (head first, upside down).

Now Hydroflex is completely cleaned.

IX. Interruption of Work

Keep the HydroFlex[®] in the same electrolyte as you are planning to use it in for normal measurements.

We recommend not to change the runtime once adjusted.

X. Disposal

The spent cartridges are like a battery disposal.

For the disposal or possible recycling of the remaining components please refer to local regulations.

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