Using Ceramic Moisture Sensors to confirm the moisture content of Hydrogen within Fuel Cells

Application Background

The hydrogen fuel cell is one of the leading alternative fuel technologies. Even though it has been in existence for at least fifty years, the recent developments represent a huge step forward in fundamental technology. Moisture plays an important part in determining efficiency, quality and safety issues relating to delivery and performance of this technology.

There are several different types of fuel cell. Because of its low operating temperature the fuel cell used to power motor vehicles is the Proton Exchange/ Polymer Electrolyte Membrane (PEM) fuel cell. In principle, a fuel cell operates like a battery. Unlike a battery, a fuel cell does not run down or require recharging. It will produce energy in the form of electricity and heat as long as fuel is supplied. A fuel cell consists of two electrodes sandwiched around an electrolyte. Oxygen passes over one electrode and hydrogen over the other, generating electricity, water and heat.

Hydrogen fuel is fed into the anode of the fuel cell. Oxygen (or air) enters the fuel cell through the cathode. Encouraged by a catalyst, the hydrogen atoms split into protons and electrons, the PEM allows only the protons to pass through it to the cathode, the electrons must take a path through an external circuit, creating an electrical current. The protons and electrons then recombine with the oxygen at the cathode, to form water.

A fuel cell system which includes a "fuel reformer" can utilise the hydrogen from any hydrocarbon fuel - from natural gas to methanol, and even gasoline. Since the fuel cell relies on chemistry and not combustion, emissions from this type of a system would still be much smaller than emissions from the cleanest fuel combustion processes. Typical process efficiency of 80% can be achieved, which is more than double that of an internal combustion engine.

Moisture Measurement

High moisture content within the hydrogen fuel yields greater process efficiency. This is related to the effectiveness of the catalytic action of splitting the hydrogen molecule into two hydrogen ions and two electrons - the driver of the process. It is clear in any case that in both the development of fuel cells, with complex and sophisticated fuel cell test stations; and also in production fuel cells, the hydrogen must be saturated with moisture at temperatures up to 80 - 90°C to gain best performance. Hence the need, in the development phase, for accurate and reliable measurement of hydrogen gas dew point within the process. Many developers benefit from using Michell Instruments Optidew Cooled Mirror Hygrometer with High Temperature sensor for these determinations. Once optimum operating conditions for the particular fuel cell have been determined, the production units can be built with an appropriate humidifier for the hydrogen fuel. Fuel Cell technologies hold promise for a greener future in the automotive industry and Michell Instruments is in a strong position to be able to provide a humidity measurement solution to suit the applications involved.

Reference Users

Opel, DVGW, Ballard Power, TH Aachen, Johnson Matthey

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