A Game-Changer for Fuel Cells.

Standard H2 has developed a revolutionary, patented system called the SULFUR MAGNET® that removes sulfur from gas streams to concentrations below 1 ppb. This breakthrough technology is a game-changer for gas cleaning needs for any process where sulfur poisoning occurs, such as fuel cells and catalysts, as well as for general air-purification systems. A recent demonstration using a commercially relevant fuel cell system shows its startling impact on fuel cell performance, which will be a welcome relief to the fuel cell industry.

A study was conducted by solid oxide fuel cell developer Nexceris that dramatically shows the ability of the SULFUR MAGNET® to improve fuel cell performance. The experimental results presented in the Figure on page 2 show that with a fuel containing 10 ppm H2S, the SULFUR MAGNET® was able to remove the sulfur such that the performance of the cell matched its performance with the high-purity H2 feed. The experiment was conducted as follows:

An anode-supported Nexceris fuel cell was tested at 700 °C with a high-purity hydrogen feed at a current density of 0.5 A/cm2. After a few hours, the cell came to a steady state voltage of 0.836 volts. The cell was operated under pure H2 with negligible degradation (25 mV/1000 hours) for an additional 15 hours to establish the baseline.

At the 20-hour on-stream mark, the hydrogen feed was directed through a cartridge of the SULFUR MAGNET® before entering the fuel cell. No change in performance was observed as the voltage was steady at 0.835 volts.

The feed was then switched to one containing 10 ppm of H2S in hydrogen that was passed through the SULFUR MAGNET® before it entered the fuel cell. The results are nothing short of remarkable.

After about 80 minutes of conditioning during which the cell voltage dropped to as low as 0.826 volts, the performance almost magically rose not merely to the previous steady state level of 0.835 volts, but to a maximum of 0.838 volts. The cell with a sulfur-containing feed that had been scrubbed with the SULFUR MAGNET® was outperforming the cell with what was believed to be pure hydrogen.

The cell was operated for an additional 15 hours under conditions of 10 ppm H2S in H2 cleaned by the SULFUR MAGNET®. During this time, the degradation of performance was about 44 mV/1000 hours, nearly the same as that measured for the pure H2 during the baseline.

Finally, the SULFUR MAGNET® was removed from the system, and the unfiltered sulfur-containing H2 feed was admitted to the fuel cell. A rapid decline in the cell voltage was noted, and after about 3 hours, the cell performance had declined to 0.748 volts, where it appeared to approach a new steady state.

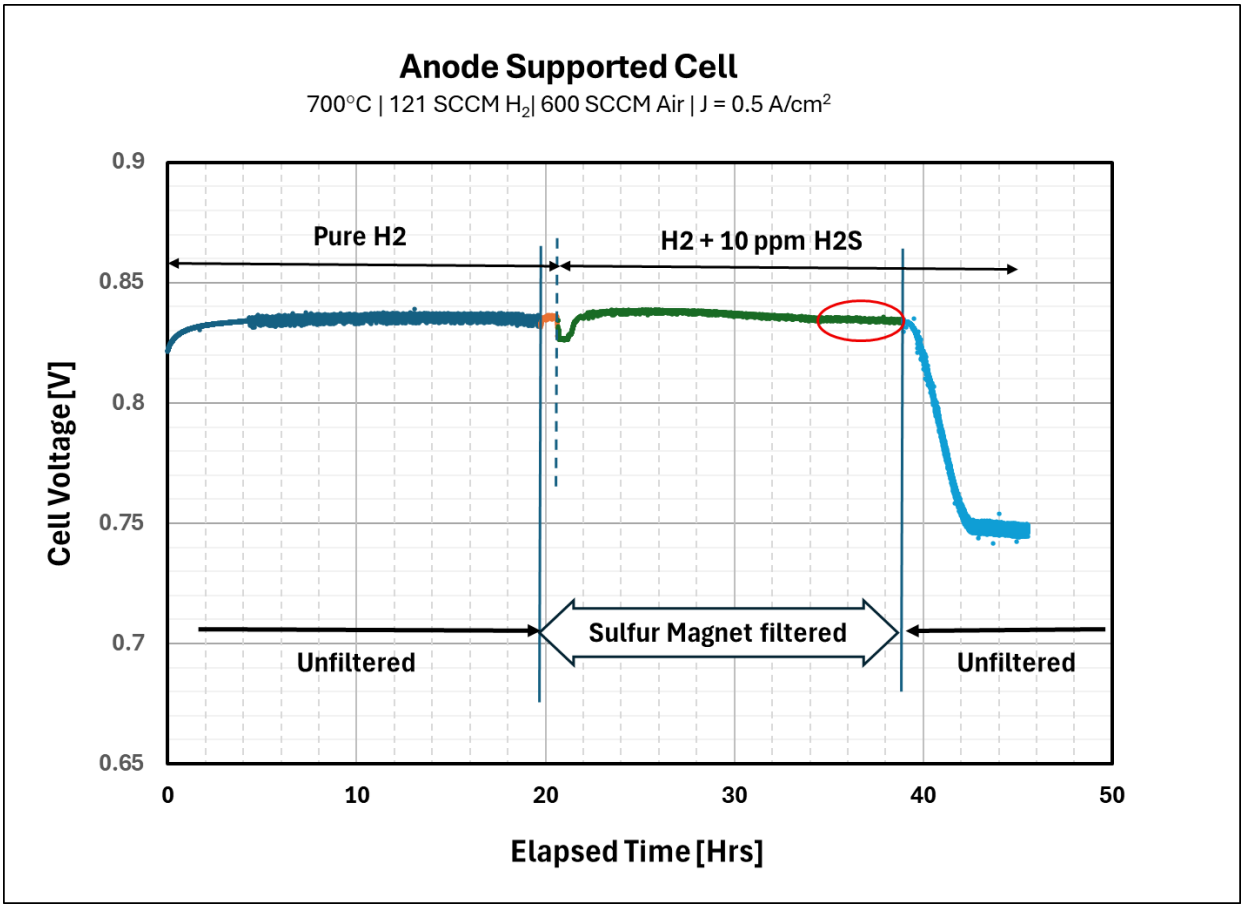

Figure 1. Fuel cell performance showing the effect of adding the Sulfur Magnet to scrub H2S from the H2 feed. Courtesy Nexceris.

As demonstrated in this test, the SULFUR MAGNET® provides a point-of-use system to remove H2S from hydrogen from any source, since even H2 produced by water electrolysis picks up trace contaminants during handling on its journey through pipes and regulators. A small cartridge placed immediately upstream of a fuel cell or other device can protect it from sulfur contamination for many thousands of hours, depending on the level of sulfur in the gas and the gas flow rate.

Work at Standard H2 continues to evaluate other uses of the SULFUR MAGNET® for the removal of trace contaminants from gas and liquid streams. For sulfur removal, the global market for solid adsorbents like the SULFUR MAGNET® is estimated at over $600 million, with about $100 million related to fuel cells. Other applications include protective masks, semiconductor manufacturing, and catalyst guard beds.