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Patenting Solid Oxide Fuel Cells and Electrolysers

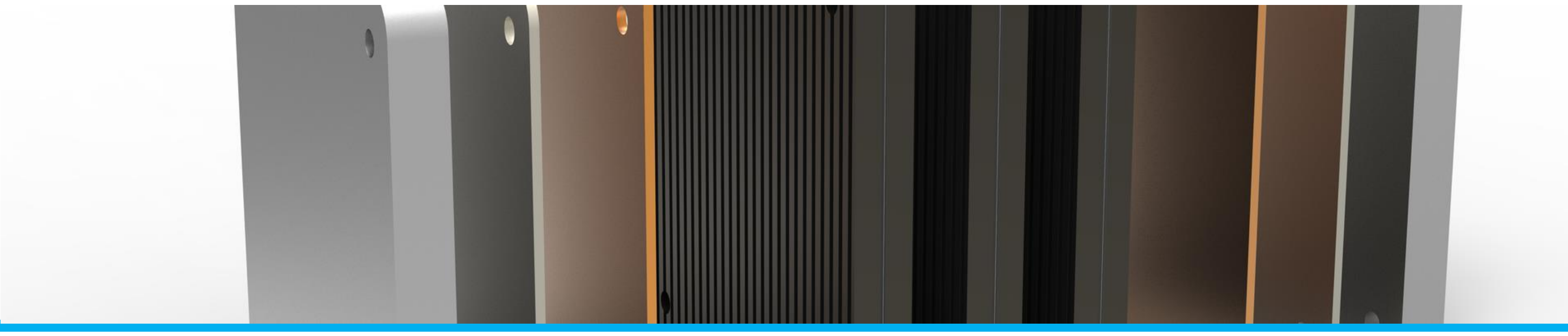
Coinciding with use of this technology on Mars, growth is predicted in the market for solid oxide fuel cells and electrolysers

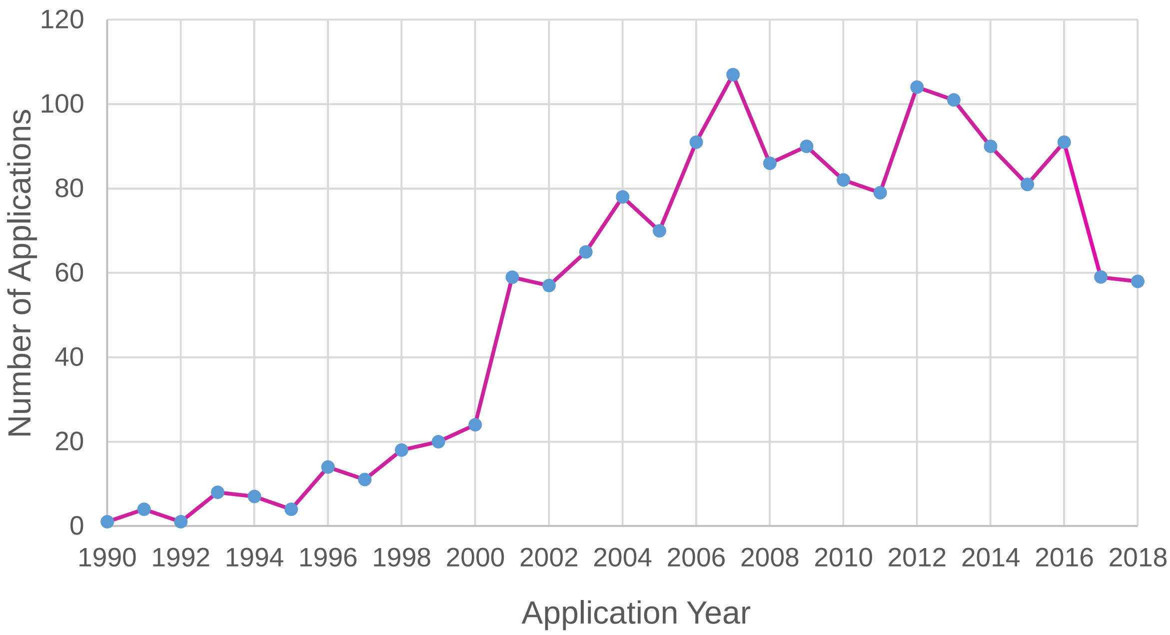
In April 2021 oxygen was artificially generated on Mars, using "MOXIE" a specially-designed device on NASA's Perseverance rover. This represents a key proof-of-concept, paving the way for manned missions to the Red Planet. At the heart of MOXIE lies a solid oxide electrolyser, enabling the carbon dioxide-rich Martian atmosphere to be converted to breathable oxygen. The MOXIE electrolyser is essentially a "fuel cell in reverse", inputting electrical energy and carbon dioxide to generate oxygen, compared to a fuel cell which inputs oxygen and fuel to generate electrical energy. Electrolysers may also be used in "water splitting" mode, inputting electrical energy and water to generate oxygen and hydrogen.

The fundamental technology behind solid oxide fuel cells and electrolysers has been around for many years. However, coinciding with its pioneering use on Mars, this technology is now poised to play an increasing role in the global switch towards greener forms of energy. In particular, a recent report is predicting growth in the global solid oxide fuel cell market of 30% year-on-year.

Solid oxide fuel cells and electrolysers have a number of advantageous properties for use in the green economy. Fuel cells provide a more efficient way of converting natural gas into electricity than conventional power generation technologies. Solid oxide fuel cells are also "fuel flexible" and can be fuelled by both natural gas and hydrogen, thus providing a stepping-stone between the current fossil fuel economy and a future zero-emission hydrogen economy. Electrolysers provide a way of converting electricity (e.g. from renewable power sources) into hydrogen, which can be stored, thus providing an alternative means of energy storage to batteries.

The maturity of solid oxide technology is reflected in the historical data on patent filings. The graph below shows PCT applications filed over the last 30 years containing the phrase "solid oxide fuel cell" in the claims, categorised under the appropriate IPC code. There was a slow increase in the number of filings over the 1990s followed by a rapid increase in the early 2000s.



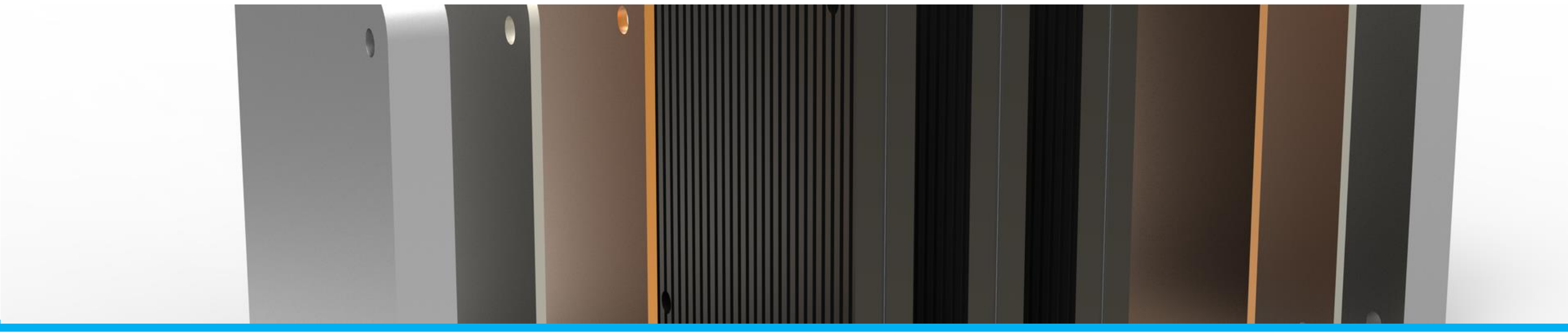


PCT applications categorised under IPC code H01M 8 with "solid oxide fuel cell" in the claims

Since patent protection only lasts for up to 20 years, it may be that many key patents covering fundamental inventions are reaching the end of their lifetimes, if not expired already. For instance, Ceres Power pioneered the use of a class of electrolyte material which enabled solid oxide fuel cells to be operated at lower temperatures than were typical at the time. This allowed other components of the fuel cell to be made from commercially-available steels, thus providing a fuel cell with advantages in robustness and simplicity of manufacture. The patent family protecting this broad concept is due to expire in late 2021 (e.g. European Patent No. 1334528), although Ceres has a large and growing patent portfolio, with many more recent filings.

This illustrates an issue faced by technologies, such as solid oxide fuel cells, which take a number of years to reach a significant position in the market. Broad field-blocking patents can expire just at the point at which they significantly increase in value. However, the nature of solid oxide fuel cells provides opportunities to mitigate this issue.

In particular, solid oxide fuel cells are complex multi-component devices which provide many opportunities for patent protection. These components span a range of technical disciplines, from the inorganic chemistry defining the precise formulation of the materials making up the anode, electrolyte, and cathode; to the materials science of how these materials are deposited and how their microstructure is controlled; and the engineering challenges of arranging the cell stacks, their interconnection, and managing the balance-of-plant. Fuel cells may be protected by a series of patents protecting each of these areas. Businesses that are actively innovating can work hand-in-hand with knowledgeable IP counsel to build extensive and diverse patent portfolios over a number of years, as their cells are optimised and successive generations are commercialised. In this way, the risk of "falling off the patent cliff" at the point when solid oxide fuel cells and electrolysers become established on the market can be minimised. Indeed, we note that this is precisely the approach that some innovators in this field, such as Ceres, are taking.



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