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Solid Oxide Fuel Cells - Promises and challenges

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The fuel cell technology offers an efficient and clean technology for the generation of electricity from fossil or renewable fuels. In contrast to the traditional power generation via heat, steam and generators, the chemical energy of the fuel is directly transformed into electricity in the fuel cell via an electrochemical process. The fuel cell technology offers major advantages such as higher electrical conversion efficiency, cleaner emissions and a quieter operation.

The fuel cell principle was discovered by the British scientist William Grove already in 1839. However, despite this a general commercialization of the technology has been slow and is still ongoing. Fuel cells were used for the first time in the NASA space program, where alkaline fuel cells supplied electrical power to the Apollo space missions. Since then, several fuel cell technologies have been developed, building on different materials for anodes, cathodes and in particular electrolytes. These have found many diverse applications such as fork lifts, telecommunication and decentralized electricity generation.

The type of fuel cell technology with the highest electrical conversion efficiencies, lowest cost and most flexible fuel requirement is Solid Oxide Fuel Cells (SOFC). SOFC are based on ceramic fuel cells and operate at very high temperatures, around 750°C. They offer electrical efficiencies up in excess of 60% and can accommodate a wide variety of available fuels including natural gas, biogas, or sewage gas. In addition, high-temperature electrolysis (SOEC) can provide the reverse process on the same platform, producing hydrogen or clean synthetic fuels from intermittent renewable sources, such as wind power.

Important milestones in the SOFC development were reached using plasma surface engineering and thin films. However, other milestones still persist, and the full-scale commercialization of the technology requires continued research and development; at the fundamental stage as well as in the applications of the technology.

Keywords

SOFC

Fuel Cell

Plasma

thin films