SOLID OXIDE FUEL CELLS

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Summary

Solid oxide fuel cells are expected to be a highly efficient power generation system. As the electrolyte, they use solid oxide conductors.

Because of their high operating temperatures, the waste heat temperature is also high, thus enabling the waste heat to be utilized to drive gas turbine and steam turbine generators, in such a way that the combined power generation system can be established. This article describes the principle and cell structure as well as component materials used.

1. Introduction

Solid oxide fuel cells (SOFCs), are a type of high-temperature fuel cell, which operate between 800 and 1000 °C (1073–1273 K).

The operating principle can be shown in Figure 1. As the electrolyte, they use oxide conductors; in general, zirconia (ZrO_2) stabilized with yttrium (Y_2O_3) or other elements is used. Stabilized zirconia is conductive through the action of oxygen ions; the following reactions occur at the two electrodes:

Fuel electrode (anode): $H_2 + 1/2O^{2-} \rightarrow H_2O + e^-$

Air electrode (cathode): $1/2O_2 + e^- \rightarrow 1/2O^{2-}$

Through movement in the electrolyte of oxygen ions, steam arising from the first reaction is discharged outside the system together with unreacted hydrogen, and the electrons pass through the external circuit.

In the overall reaction, hydrogen and oxygen combine to generate steam like any other type of fuel cells described in the foregoing sections.

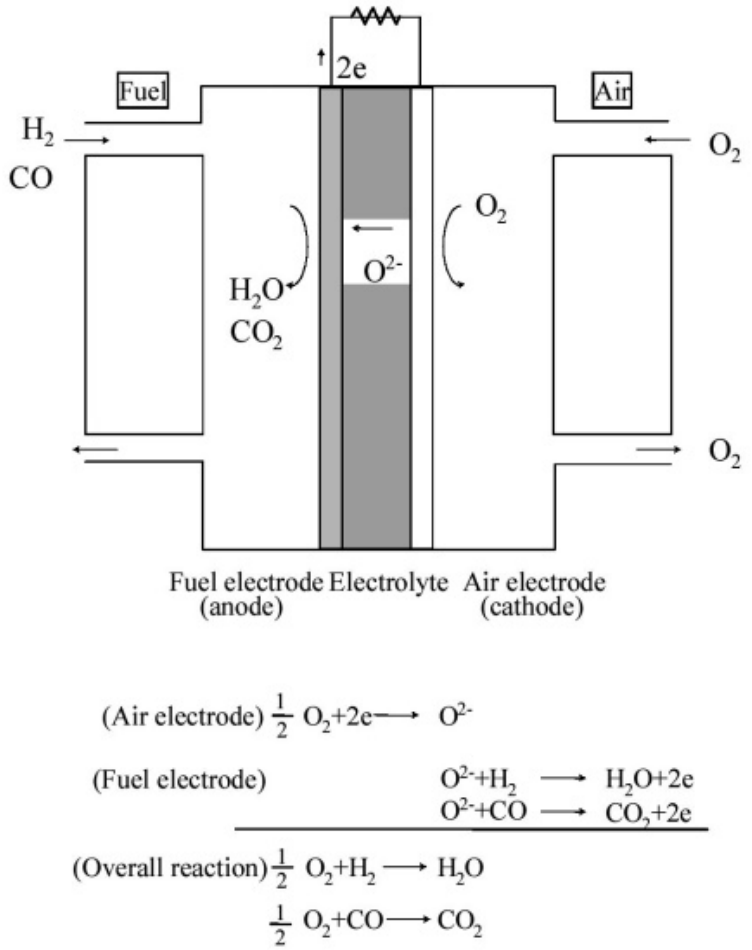

Figure 1. Principle of Operation of Solid Electrolyte Fuel Cells

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Biographical Sketch

Atsushi Kimura was born 24 January 1966, in Japan. He has received his education from the Department of Technology of Inorganic Material Science, Tokyo Institute of Technology and has a masters degree.