

Choice of SOFC Structural Component

Design Options

A key design decision in the SOFC development process is choice of method of structural support. Three types are typically described in the literature, Anode Supported, Cathode Supported and Electrolyte Supported, meaning that the thickness of the specified layer is increased such that it provides a mechanically strong structure onto which the other layers are 'bonded'. There is another design, that I shall call Substrate Supported in which a structurally strong 'module' is produced from a non electrochemically active substrate onto which 'thin' layers of the electrochemical components (electrochemical membrane) are laid down. Somewhat confusingly, in the literature, this type of design would be referred to as Anode or Cathode Supported (depending upon which electrode was in contact with the substrate). In this case the substrate would be referred to as the Anode/Cathode and the Anode/Cathode section of the electrochemical membrane referred to as the Anode/Cathode Active Layer.

Electrolyte supported designs are favourable only at high operating temperatures (1273K) due to the high Ohmic resistance of electrolyte materials at lower temperatures.

As well as lower ohmic resistance, electrode supported designs are expected to have the added benefit of lower activation polarisation, particularly when composite electrodes are formed allowing thickening of the reaction zone (details to follow). The problem faced by designers of electrode supported SOFC's, is high concentration polarisation resulting from the resistance to gas transport through thick, porous electrodes. This is being addressed by grading the porosity of the thickened electrode – an example of which is the high porosity substrate and lower porosity anode active layer of the Rolls-Royce design.

Chosen Designs

The Westinghouse SOFC is a cathode supported design, in which mechanical integrity is provided by a 2mm thick airside electrode.

The Rolls-Royce SOFC is Anode-Side Substrate Supported, with structural support provided by a ceramic substrate module to which the anode is bonded.

References:

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