# THE ROLE OF PROCESSING ON THE DEVELOPMENT OF HIGH PERFORMANCE SOLID OXIDE FUEL CELLS

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Fuel cells are considered to be a key technology for the future of electricity generation. In a fuel cell, the chemical energy of a fuel is directly converted into electrical energy in an electrochemical reaction without combustion. As a result, fuel cells offer high energy conversion efficiency and low emissions relative to other conventional means of generating electricity. Solid oxide fuel cells (SOFCs) are a type of fuel cell that utilize a ceramic electrolyte and operate at elevated temperatures, which provides SOFCs with fuel flexibility and makes them well suited for combined heat and power applications. The theoretical efficiency of SOFCs is not governed by size when compared to Carnot or Rankine-cycle based energy production. Thus, SOFCs can be utilized for various applications with different power scales – auxiliary power units, distributed generation or stationary power production.

Increased interest in SOFCs has resulted in much research being devoted to materials and manufacturing process development worldwide. A major challenge is to choose materials for different components that are not only functionally adequate (e.g., ionic conducting for electrolyte and electronic conducting for electrodes) but are also compatible with each other and the chemical environment to which the materials are exposed. Similarly, the processes that are chosen for making SOFCs must produce cells that are high performance, thermomechanically robust and can facilitate high yield and low cost. If care is not taken in selecting appropriate materials and processes, deleterious microstructure changes, interdiffusion, spallation and loss of electrical contact can occur. However, if managed properly through choice of materials, processing and design intent the result is an electrochemically robust cell design. In order to ensure the emergence of cost-competitive solutions, the development effort at Versa Power Systems has emphasized the use of conventional materials where possible (such as yttrium-stabilized zirconia and nickel) and early introduction of volume manufacturing processes (tape casting, screen printing, continuous co-firing). This paper will present the role of processing on the development of high performance solid oxide fuel cells.

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