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Bloom Energy From Legacy Fuel Cell

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Abstract:

We have many problems due to produce electricity for during generation and future generation. So we need to produce electric energy in the form of reliable, flexible, less polluting and continuous supply of electric energy from a cheap material. Our paper shows how to produce this kind of electric energy, that Energy is called as 'Bloom energy'**.** The Bloom Energy is the manufacturer of solid oxide fuel cells. It is the 'heart of every energy server'. Solid oxide fuel cell is defined as the 'distributed generation solution that is clean and reliable and affordable all at the same time'. Reportedly, the solid oxide fuel cells are as efficient as much as doubly efficient as a conventional power plant. "A solid oxide fuel cell is an electrochemical cell that converts a source fuel into an electrical current. It generates electricity inside a cell through reaction between a fuel and an oxidant, triggered in the presence of an electrolyte".The reactants flow into the cell and reaction products flow out of it while the electrolyte remains within it. Each fuel cell, which consists of a metal alloy plate sandwiched between two ceramic layers, generates 25 watts of power. Solid oxide fuel cell made by methane and oxygen. A single fuel cell can power a light bulb, but a one solid oxide fuel cell is producing 2KW electricity. Bloom refers to as "legacy fuel cells." Energy Servers can use a variety of source fuels, including biofuels.

Introduction:

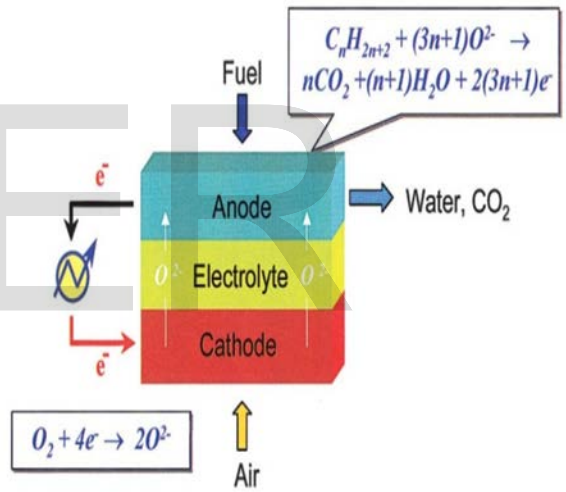
The Bloom Box was formally introduced to the public at eBay's headquarters in San Jose, Caliph by the founder and CEO of Bloom energy, Dr.K.R.Sridhar. He introduced it as "It's the plug-and-play future of electricity Idea of bloom energy**.** He began developing the technology as part of an effort to make Mars habitable for humans.

The idea is to one day replace the big power plants and transmission line grid clean energy have seen the technology and it works, "former Secretary of State Colin Powell said. Bloom Energy is a Distributed

Generation solution that is clean and reliable and affordable all at the same time.

The first customer of bloom box is Google. Four units have been powering a Google datacenter for 18 months.

Generation Of Bloom Energy:



- The technology is based on solid oxide fuel cells, which works like a battery but has a persistent source of fuel, such as natural gas to keep the electricity flowing.
- Bloom's energy three-layer solid oxide fuel cell produces clean and potentially affordable power by an electrochemical process.
- Steam and fossil or renewable fuel combine to create a "reformed" fuel. This flows over the anode side.
- Warm air flows across the cathode side.
- Electrolyte allows only oxygen ions from the cathode to pass through to the anode.

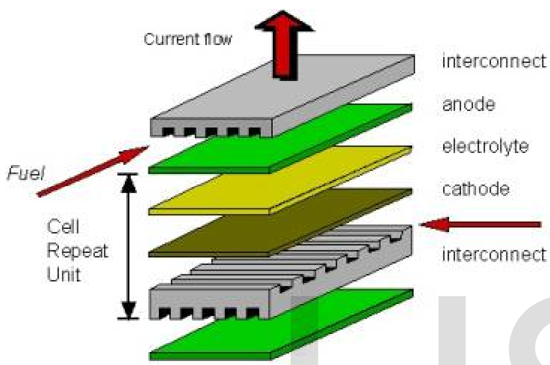
The chemical reaction of oxygen ions and reformed fuel produce electricity, water, heat and a small amount of carbon dioxide.

The water and heat are reused to repeat the process.

Design Of SOFC:

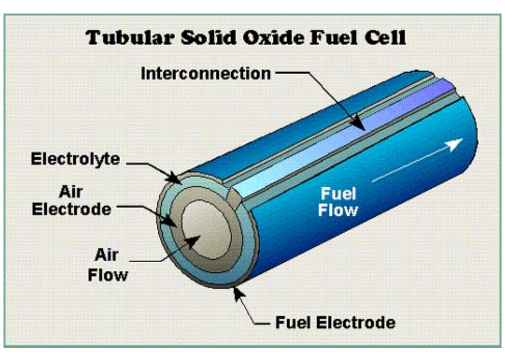
- Planar design
- Tubular design.

Planar Design SOFC:



In the planar design, the components are assembled in flat stacks, with air and fuel flowing through channels built into the cathode and anode.

Tubular Design:



In the tubular design, components are assembled in the form of a hollow tube, with the cell constructed in layers around a tubular cathode; air flows through the inside of the tube and fuel flows around the exterior.

Components Of Solid Oxide Fuel Cell:

- Anode(NI-YSZ)
- Cathode($LaMnO_3$)
- Electrolyte(LSGMC)

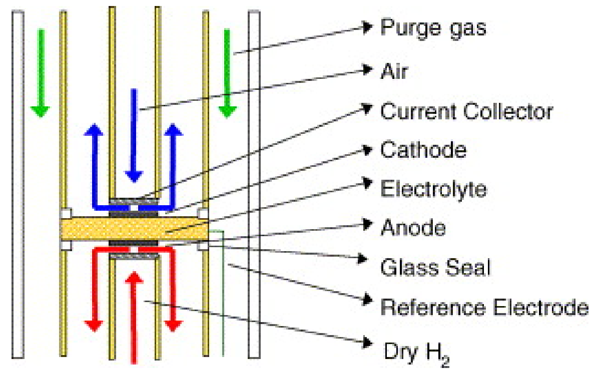


Fig: Components of Solid Oxide Fuel Cell

Anode:

The state of the art anode material used in Solid Oxide Fuel Cells is the Ni/YSZ ceramic-metal (cermet) composite (where YSZ = Y2O3/ZrO2) which has several difficulties in use. A spherical core–shell structure consisting of a micron-sized Ni (core) and nano-sized YSZ (shell) was prepared by a high-speed mixing technique from metallic a Ni and YSZ powder mixture. The core–shell Ni–YSZ powder was then heat-treated at 1450 °C in an air atmosphere. During the early stage of the heat-treatment between 300 and 550 °C, it seemed that the surface of the Ni core was oxidized and the Ni particles were coated with a relatively dense NiO thin layer.

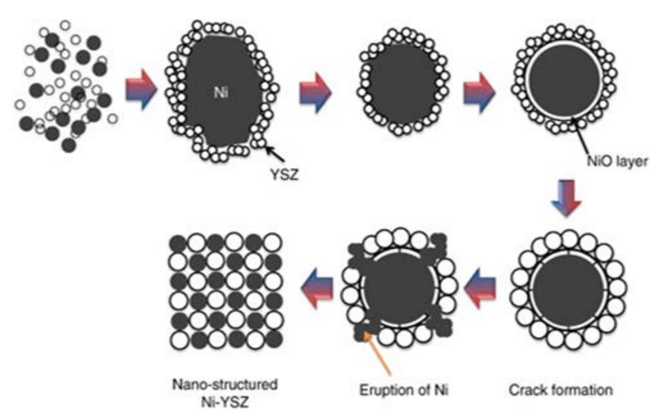


Fig: Formation of Nickel yttria-stabilized zirconia

As the heat-treatment temperature increased, the Ni core particles erupted, which led to uniformly distributed Ni particles in the YSZ framework. The resulting Ni–YSZ composite exhibited better electrical conductivity and ASR for anode polarization than a commercially available Ni–YSZ cermet anode.

The highest triple-phase boundary (TPB) density was at a Ni:YSZ volume ratio of .

Advantage:

We synthesized a core-shell Ni–YSZ composite powder by a high speed mixing technique.

A Nano Ni–YSZ powder can be obtained by heat-treating the Ni–YSZ in air atmosphere.

The obtained anode showed good electrical conductivity and polarization resistance.

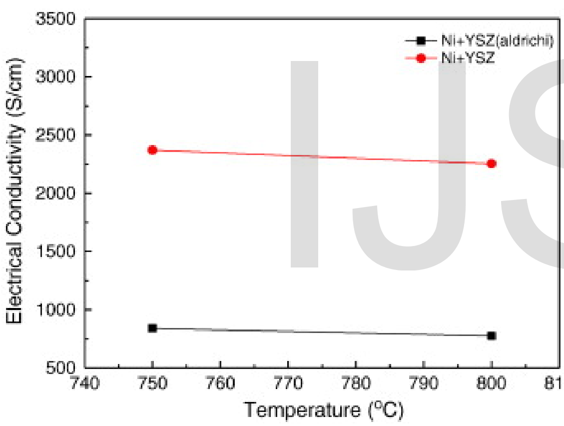


Fig. Electrical conductivities of the Ni–YSZ composite samples.

Applications:

- The perovskite anode can be used in any Solid Oxide Fuel Cell (SOFC)
- The world fuel cell market is predicted to more than triple by 2005 to US$8.5 billion, and exceed US$23 billion by 2010.
- The University would welcome enquiries from commercial parties interested in developing commercial applications of fuel cells and fuel cell materials.

Cathode:

Effect of water content in starting powder mixture of La2O3 and Mn3O4 on mechano chemical reaction of lanthanum manganite (LaMnO3) fine powder was investigated. LaMnO3 (M=Co, Mn) have been obtained by a sol–gel-like method with propionic acid as solvent. The influence of the nature of the metallic source (metal, nitrate or chloride) on the gel formation has been studied by fourier transform infrared spectroscopy (FTIR) and thermo gravimetric analysis ATD–ATG. After calcination, the obtained perovskites have been characterised by X-ray diffraction (XRD), FTIR, X-ray photoelectron spectroscopy (XPS) and scanning electron microscopy (SEM) in order to investigate the influence of the preparation parameters on the final product. These mixed oxides have been used as catalyst for the destruction of chlorinated compounds. For each compound, the perovskite structure of LaCoO3 decomposes in the same manner as LaOCl and Co3O4. Under the same test conditions, the perovskite with Mn is not altered. The stability of the structure has been explained by the formation of an oxygen overstoichiometric phase (LaMnO3+δ) which is thermodynamically more resistant to chlorination than the stoichiometric LaMnO3. The catalytic behaviour of these oxides shows that two ways (hydrolysis and oxidation) are involved in the destruction of chlorinated hydrocarbons. The first one requires acidic sites and is less sensitive to the modification of the catalyst surface induced by chlorine than the second one requiring metallic oxidation sites.

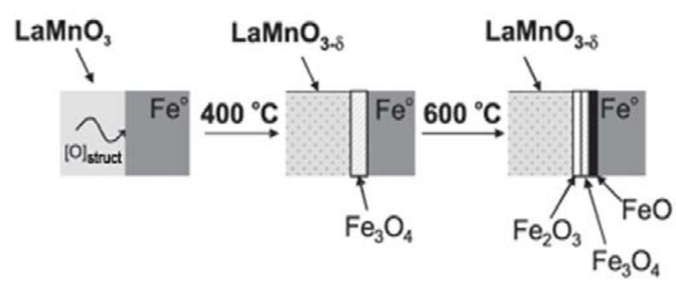


Figure 5. Scheme for the oxygen transfer from $LaMnO_3$ to Fe°, forming different iron oxide phases.

Advantage:

low cost raw materials.

simplicity of the process and the ability to obtain fine powder.

the single phase $LaMnO_3$ fine powder was obtained after milling only for 30 min.

Electrolyte:

A low temperature (≤650 °C) process for fabricating nano-structured (La, Sr) (Ga, Mg, Co)$O_{3-\delta}$ (LSGMC) electrolyte/(La, Sr) (Co, Fe)$O_{3-\delta}$–(Gd, Ce)$O_{2-\delta}$ (LSCF–GDC) cathode films, ~7 and ~25 μm in thickness, respectively, was developed using an aerosol deposition (AD) process for use in intermediate temperature solid oxide fuel cells (IT-SOFCs).

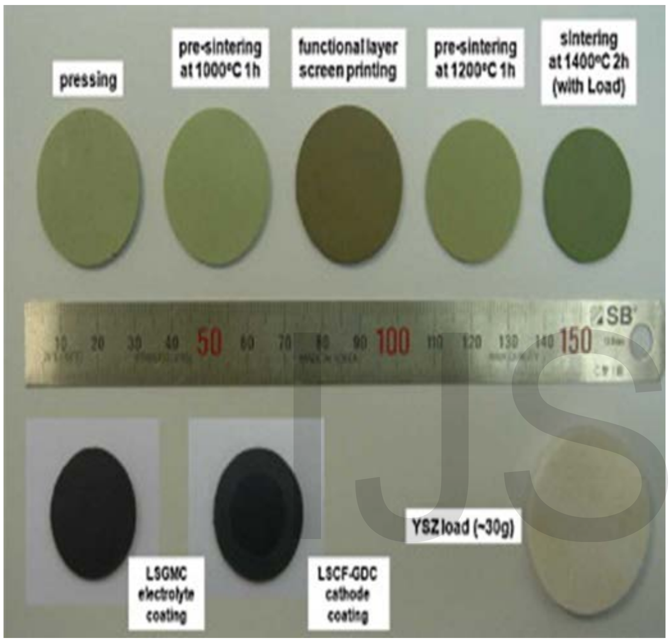


Fig: LSGMC electrolyte deposition at each preparation step.

NiO–GDC was used as an anode substrate in anode-supported type cells. The deposited LSGMC electrolyte and LSCF–GDC composite cathode film maintained good adhesion with the NiO–GDC anode, even though the coating processes were completed at the room temperature. The LSGMC electrolyte was composed of nano-sized grains smaller than 30 nm. The electrical conductivity of the LSGMC electrolyte fabricated at room-temperature was ~30 mS/cm at 650 °C.

Advantage:

Good adhesion

The coating processes were completed at the room temperature

Nano-sized grains smaller than 30 nm

Interconnect:

To build up a useful voltage, a number of solid oxide fuel cells (SOFCs) are electrically connected in series in a stack via interconnects. In addition to functioning as bipolar plates, the interconnects also act as separator plates, physically separating the fuel in the anode from the air or oxygen in the cathode, and at the same time help maintain the structural integrity of the SOFC stack. Depending on the stack operating temperature, both ceramic and metallic materials are used to construct interconnects. Owing to their high-temperature stability, ceramic materials, typically chromites, are used for stacks operating at higher SOFC temperatures of 900–1000 °C.

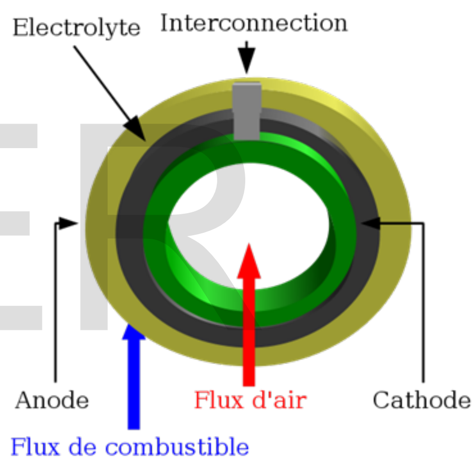


Fig :Interconnection

However, at operating temperatures in an intermediate range of 650–800 °C, metallic materials, e.g., high-temperature oxidation-resistant metals/alloys, are preferred to ceramic materials. This article provides a comprehensive review of interconnects, made from both ceramics and metallic alloys, with a focus on recent progress in materials development, as well as on advances in understanding materials degradation and interfacial phenomena under SOFC operating conditions.

Benefits:

Clear Energy: Bloom Energy Delivers Better Electrons.

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All electrons are not equal. Only Bloom energy delivers clean energy i.e electrons that are clean and reliable and affordable.

Reduce Energy Costs: Lower & Lock-In Energy Costs

Save Money & Environment

Bloom allows you to save money first. The efficiency built into Bloom's fuel cell systems allows a typical customer to achieve a 3-5 year financial payback making it an easy and economically sound choice.

Customers can also reduce their co2 emissions by 40%-100% compared to the U.S. grid.

Applications Of Bloom:

Historically, businesses have been required to install many different energy technologies to address all their energy needs. To ensure power reliability, they purchased costly backup solutions. For increased power quality, they purchased power conditioning equipment. If they simply wanted clean power, they installed solar panels or purchased Renewable Energy Credits. All individual solutions that solve individual problems.Bloom Energy's versatile fuel cell technology is essentially a flexible energy platform, providing multiple benefits simultaneously for a wide range of applications. In addition to clean, reliable, affordable electricity, Bloom customers can realize a multitude of other advantages:

• Carbon Sequestration: The electrochemical reaction occurring within Bloom Energy systems generates electricity, heat, some H2O, and pure CO2. Traditionally, the most costly aspect of carbon sequestration is separating the CO2 from the other effluents. The pure CO2 emission allows for easy and cost-effective carbon sequestration from the Bloom systems.

• Reverse Backup: Businesses often purchase generators, uninterruptible power supplies and other expensive backup applications that sit idle 99% of the time, while they purchase their electricity from the grid as their primary source. The Bloom solution allows customers to flip that paradigm, by using the Energy Server as their primary power, and only purchasing electricity from the grid to supplement the output when necessary. Increased asset utilization leads to dramatically improved ROI for Bloom Energy's customers.

• Time to Power: The ease of placing Bloom Energy Servers across a broad variety of geographies and customer segments allows systems to be installed quickly, on demand, without the added complexity of cumbersome combined heat and power applications or large space requirements of solar. These systems' environmental footprint enables them to be exempt from local air permitting requirements, thus streamlining the approval process. Fast installation simply requires a concrete pad, a fuel source, and an internet connection.

• DC Power: Bloom systems natively produce DC power, which provides an elegant solution to efficiently power DC data centers and/or be the plug-and-play provider for DC charging stations for electric vehicles.

• Hydrogen Production: Bloom's technology, with its NASA roots, can be used to generate electricity and hydrogen. Coupled with intermittent renewable resources like solar or wind, Bloom's future systems will produce and store hydrogen to enable a 24 hour renewable solution and provide a distributed hydrogen fueling infrastructure for hydrogen powered vehicles.

Disadvantages of High Temperature SOFC

Material costs are high, particularly for interconnect and construction materials. Interconnects carry electrical current between individual cells in the stack and can also act as a separator between the fuel and oxidant supplies. In high temperature SOFC the interconnect may be a ceramic such as lanthanum chromite, or, if the temperature is limited to <1000°C, a sophisticated refractory alloy e.g. based on mechanically alloyed Y/Cr. In either case the interconnect represents a major proportion of the cost of the stack. Stack construction materials and balance of plant also need to be refractory enough to contain and manipulate the high temperature gas streams.

Operation of the SOFC at a reduced temperature can overcome some of these problems and bring additional benefits.

Operation at less than 700°C means that low cost metallic materials

Lower temperature operation offers the potential for more rapid start up and shut down procedures.

Reducing operating temperature simplifies the design and materials requirements of the balance of plant.

Reducing the operation temperature significantly reduces corrosion rates.

This drawback is overcome by using components in following way,

Electrolyte-doped ceria

Cathode-(La,Sr)(Co,Fe)o(LSCF)

Anode-Ni-ceria

Interconnect-LSC

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