EDITORIAL

# Possible advantages of silicon carbide in electrolyte-layer free fuel cell

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In the history of fuel cell since the invention and demonstration of Sir William Grove in 1839, several challenges have been faced by the technology. Some of the challenges are related to capital and operational costs of the technology while many other challenges are related to the operational mechanism [1-4]. To solve these challenges, several attempts have been made by researchers from different perspectives. In order to improve the operation of the devices, new materials have been investigated to improve the functionality. All of the fuel cell devices have their activation energies which can be calculated from performance plot of the device. Solid oxide fuel cell (SOFC) also needs activation energy to perform the redox reactions. Electrolyte-layer free fuel cell (EFFC) is a relatively new technology into the SOFC, invented in 2010 by Bin Zhu and colleagues [5,6]. EFFC has several advantages over other fuel cell types; it has several challenges as well which need to be addressed with the passage of time. One of them is the activation energy of the device and time expansion to activate the inner and outer body of the device. Usually, it happens that core part of the device takes longer time to be activated as compared to the outer part. This could be due to less thermal conductivity of the materials that are used to fabricate the devices. It is suggested here that if a material with higher thermal conductivity could be mixed homogeneously in the semiconductor-ionic material of the EFFC before its fabrication, it may affect positively on the performance of the device because the material may help the device to activate internally and externally faster due to fast heat conduction.

Silicon Carbide (SiC) is a material known for higher thermal conductivity [7]. It is expected that if this material (e.g. 10% by weight) is mixed homogeneously into the semiconductor-ionic material. It may help to reduce the activation energy of the EFFC because of its fast heat transportation internally from one end of the cell to the other. So, here is an understanding from thermal conductivity perspective that using SiC may enhance the performance of the device and it can work more efficiently with fast operations and activation. From another perspective, it has been identified that the electrical conductivity of commercial SiC measured by DC 4 Probe method is not changing a lot in low and intermediate temperature range (300°C-650°C) which means that by using SiC material in EFFC, this may help in the cell stability. It has been observed through top-bottom approach that the electrical conductivity of commercial SiC at 650°C is referred to 88 S/cm and then conductivity reduces at 600°C referred to 44 S/cm and then it remains unchanged until the temperature is reduced until 300°C. This shows that electrical conductivity is stable in a long range of temperature 300°C-600°C which is really a targeted working range for EFFC. It is expected that this property of SiC may help to enhance the stability and performance of low temperature SOFC and EFFC. By further decrease in temperature below 250°C, it is observed that conductivity is again changed and increased referred to 88 S/cm. Conductivity measurements were performed in air atmosphere and the pure SiC pellet was showing also a stable open circuit voltage (OCV) of 35 mV. In our upcoming experiments, we are going to use SiC material in single component material of EFFC due to its potential properties of higher thermal conductivity and almost good stable electrical conductivity for a long range of temperature [7]. Hence, the new results will be published in [8-10] the international journals accordingly.

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