

# Fuel cell innovation: Novel cathode materials with high performance and strong reliability at intermediate temperature

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Prof. Guntae Kim. Credit: UNIST

Research team of Ulsan National Institute of Science and Technology (UNIST), Georgia Institute of Technology, and Dong-Eui University developed a novel cathode material which has outstanding performance and robust reliability even at the intermediate temperature range.

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As high [power density](#) devices, fuel cells can convert [chemical energy](#) directly into electric power very efficiently and environmentally friendly. Solid oxide fuel cells (SOFCs), based on an oxide ion conducting [electrolyte](#), have several advantages over other types of fuel cells, including relatively inexpensive material costs, low sensitivity to impurities in the fuel, and high overall efficiency.

To make SOFC technology more affordable, the operating temperature must be further reduced so that substantially less expensive materials may be used for the cell components. Also there will be more choices of materials for other components with lower operating temperature.

However, at the low operating temperature, the problem is that the efficiency drop by the cathode is especially dramatic than the one due to the [anode](#) and/or electrolyte. It means that the cathode, as a key component of SOFC, contributes the most to the polarization loss during intermediate temperature operation. As a result, the development of feasible low temperature SOFCs requires the generation of highly efficient cathode materials.,

A UNIST research team tried to co-dope Sr and Fe and succeeded in yielding remarkable out-performance to present materials at lower operating temperature. The optimized composition has facilitated excellent oxygen reduction reaction and the novel structure has created pore channels that dramatically enhance oxygen ion diffusion and surface oxygen exchange while maintaining excellent compatibility and stability under operating conditions.

"The hardest part of this research was finding optimum composition of Sr and Fe for the best performance and robustness," said Prof. Kim. "Previously various researches trying to dope Sr to perovskite structure had been made by many other groups. But none of them was successful for the better performance at the low operating temperature."

The new material developed by the UNIST research team led by Prof. Guntae Kim, could be used at significantly low temperature SOFC with higher efficiency and solid reliability than the previously reported materials.

This new novel [cathode material](#) enables the fuel cell designers have more flexible choices on the materials of fuel [cell components](#), which leads to the lower fuel cell cost and, finally, to the step closer to the highly efficient and reliable fuel cells.

**More information:** Highly Efficient and robust cathode materials for low-temperature solid fuel cells:  $\text{PrBa}_{0.5}\text{Sr}_{0.5}\text{Co}_{2-x}\text{Fe}_x\text{O}_{5+?}$ , *Scientific Reports*, 2013.

Provided by Ulsan National Institute of Science and Technology

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