Fuel reforming technology for enhancing fuel flexibility of thin film LT-SOFCs

Joongmyeon Bae(jmbae@kaist.ac.kr)
KAIST

Abstract

Fuel cells are energy conversion systems that directly convert chemical energy to electrical energy. They convert power efficiently and have a higher energy density than internal combustion engines. Due to the above characteristics, fuel cell systems are currently considered as alternative power sources for specialized systems such as unmanned aerial vehicles, unmanned underwater vehicles, and robots. Studies throughout the world have mainly focused on R&D projects for developing military systems.

However, in the case of the current hydrogen storage technologies, e.g., high-pressure hydrogen tanks, liquefied hydrogen tanks and hydrogen storage alloys are not easily applicable to compact systems with low loading capacity. In this study, we propose a compact reforming system using liquid fuels as a technology to enhance the fuel flexibility of fuel cells. We intend to achieve a system that can store and supply hydrogen with a higher energy density than the conventional systems. Moreover, we explore our strategy to realize a next generation fuel cell system that can utilize low-priced materials, improve start-up capability, minimize size, and reduce weight by combining the low-temperature thin film solid oxide fuel cell (SOFC) technology.

In this study, we developed a Ni-based bimetallic catalyst with high activity even at low temperatures. We also established a coating process that is applicable to a monolithic structure. Then we designed and built a compact reforming system for testing the performance of our catalysts. As a result, the conversion of liquid hydrocarbons (both ethanol and dodecane) was 100% at a low temperature of 550 °C while greatly reducing the catalyst loading. We also succeeded in designing a stable process of manufacturing low-temperature SOFCs using a thin film electrolyte. Finally, we conducted experiments that combined a reformer and an SOFC. We evaluated the SOFC performance by supplying the reformate gas from the reformer directly to the SOFC.

Keywords: *liquid fuel, reforming, hydrogen, low temperature, SOFC*

Biography

Joongmyeon Bae is a professor in the Department of Mechanical Engineering at Korea Advanced Institute of Science and Technology, where he has been since 2002.

He received a Ph.D in material science from Imperial College in 1996. He received both of B.S. and M.S. from Seoul National University in 1989 and 1991, respectively.

He has focused his career on developing new energy conversion technologies especially, liquid fuel reforming and solid oxide fuel cells.