News Release

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Nippon Telegraph and Telephone Corporation
Toho Gas Co., Ltd.
Sumitomo Precision Products Co., Ltd.

Development of power generation module with solid oxide fuel cells for commercial use

-Achievement of world's top-level electrical conversion efficiency-

Nippon Telegraph and Telephone Corporation (NTT; Head office: Chiyoda-ku, Tokyo; President and CEO: Satoshi Miura), Toho Gas Co., Ltd. (THG; Head Office: Nagoya, Aichi; President and CEO: Takashi Saeki), and Sumitomo Precision Products Co., Ltd. (SPP; Head Office: Amagasaki, Hyogo; President and CEO: Susumu Kaminaga) have jointly developed a 3 kW class power generation module for commercial use with solid oxide fuel cells (SOFCs[*1]). A power generation trial with town gas as the fuel achieved a world's top-level electrical conversion efficiency of 59% (LHV[*2]).

<Background>

The 1st commitment period of the Kyoto Protocol (2008-2012) has arrived and greenhouse gas reduction is an urgent worldwide task. Fuel cell systems have the potential to generate clean electrical power and so help to reduce CO2 emissions. Fuel cell systems can produce stable electrical power using fuels such as town gas with a high conversion efficiency independent of power generation scale. Solid oxide fuel cell (SOFC) systems can provide the highest electrical conversion efficiency (45 to 60%) of the various kinds of fuel cell systems. A total (overall) efficiency of 80 % can be achieved by using the exhaust heat. Accordingly, SOFC systems are promising as clean power sources of the future.
The core components of an SOFC system are the cells that act as power generation elements, the stacks in which the cells are assembled and electrically connected, and the power generation module that provides appropriate stack operating conditions. The integration of each component technology is a key issue in terms of realizing an SOFC system. Based on this understanding, NTT, THG and SPP have been collaborating on the integration of their technologies.

<Technical features>

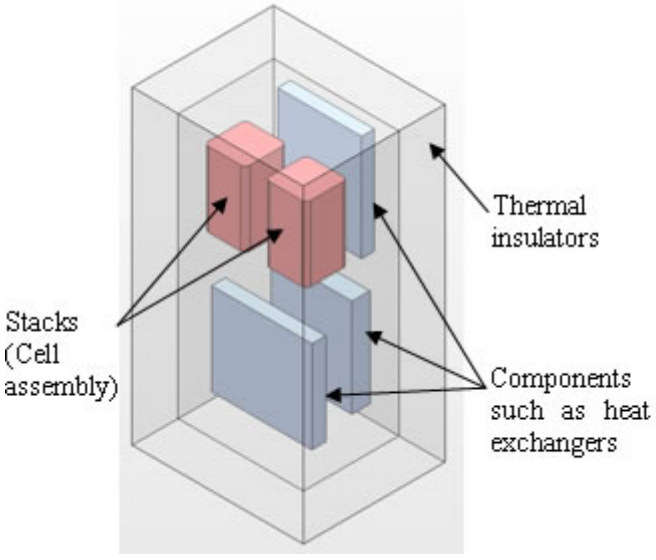
The technical features of the power generation module reported here are (1) high performance stacks, (2) an advanced heat flow design and (3) enhanced heat insulation. As a result, thermally self-sustainable operation[*3] was confirmed for hundreds of hours with a stable power output and an electrical conversion efficiency of 56 % (LHV). A world's top-level efficiency of 59% (LHV) was also realized for a short period of time. The technological features are as follows.
(1) High performance stacks were developed using planar SOFCs that have a high power output and durability. This enabled the module to achieve highly efficient and stable power generation.
(2) An advanced heat flow design allows the optimum use of heat. Heat loss was minimized by exchanging exothermic heat from the stack for air heating and other endothermic processes. The design also contributed to the isothermal control of the

stack temperature and helped the stack operate stably.
(3) Enhanced heat insulation minimized the unused heat emission and contributed to the highly efficient operation.

<Future plan>
NTT, THG and SPP plan jointly to confirm the performance of SOFC systems based on this module technology, and to develop practical systems for commercial use within a few years.

<Terminology>
*1Solid Oxide Fuel Cell, SOFC
A power generation element consisting of a solid oxide (ceramic) electrolyte that converts fuel energy directly to electricity. The minus and plus electrodes are called fuel and air electrodes, respectively. The oxide ions produced at the air electrode diffuse through the solid electrolyte and oxidize the fuel at the fuel electrode, leading to electricity generation. The operating temperature is generally high at 600-1000 °C with low reaction losses, resulting in high efficiency. Other notable features are that a noble metal catalyst is unnecessary and the high temperature exhaust heat is useful.
*2LHV (Lower Heating Value)
A heating value that excludes the latent heat of steam condensation.
*3Thermally self-sustainable operation
Isothermal operation of power generation module using generated heat associated with electricity generation process (without external heating).

<Figures>
(1) Component arrangement of power generation module (left)
(2) Appearance of power generation module (right)



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