A4
Development of Hydrogen production technology by high temperature(>850℃) steam electrolysis

In this research, the technology to produce hydrogen efficiently by means of high temperature steam electrolysis will be developed using solid oxide electrolysis cells. The technology includes
- Material for highly active hydrogen and air electrodes of cell
- Establishment of technology to fabricate scalable large-area single cells
- Development and demonstration of all-ceramic stack module to be operated above 850℃

Goal

Development of high temperature (850℃) steam electrolysing module using all-ceramic stack

- Materials and fabrication technologies for high performance cell
  - Hydrogen electrode material: polarization resistance < 0.1Ω/cm², durability > 2,000 hours
  - Oxygen electrode material: polarization resistance < 0.3 Ω/cm²
  - Ceramic interconnect material: sintered density > 95%, electrical conductivity > 40 S/cm
- Fabrication technology of close-end flat tubular cell
  - Improvement of microstructure and flatness of electrode support
  - Coating of dense electrolyte and ceramic interconnect
- Core technology to fabricate highly efficient all-ceramic stack
  - Simulation and design of flow channels and stack structure
  - Development of highly conductive and higly tough ceramic current distributor: ASR < 100 mΩ·cm²
  - Evaluation of all-ceramic stack for hydrogen production at the rate of 0.35 Nm³/hr

Objective

- 1st year
  - Establishment of unit cell fabrication process and
  - Computer simulation of the flow channels for high temperature electrolysis stack
  - Fabrication of 10-cell stack
- 2nd year
  - Development of oxide hydrogen electrode and interconnect
  - Improvement of the durability and hydrogen production efficiency of unit cell
  - Design and simulation of tubular stack
  - Evaluation of 20-cell stack
- 3rd year
  - Understanding of polarization by hydrogen and air electrodes
  - Improvement of the durability and hydrogen production efficiency of unit cell
  - Design and fabrication of BOP
  - Fabrication of 0.2 Nm³/hr-stack module

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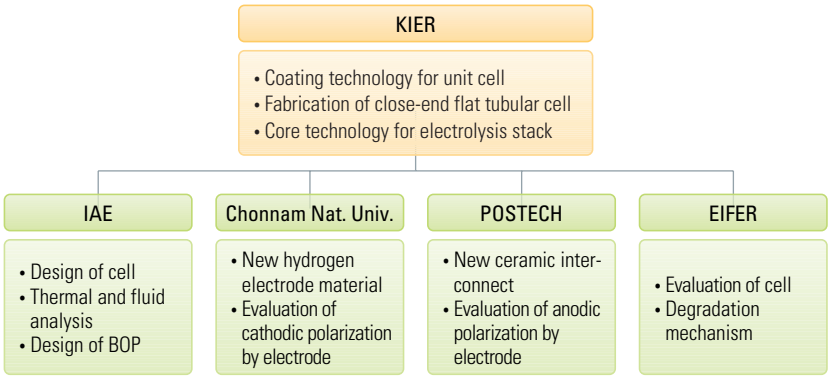
- 4th year
  - Improvement of the durability of unit cell
  - Fabrication and operation of 0.35 Nm^3/hr-stack module

Strategy



Outcomes & benefits

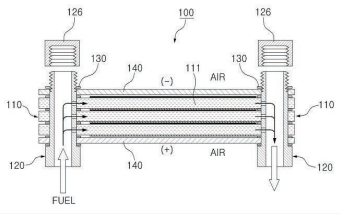
- Core technologies to produce efficient and large-scale HTE system
- Hydrogen production by industrial heat waste, nuclear reactor, solar-thermal reactor
- Hydrogen supply to fuel cells for vehicles and distributed power plan

Publications (2nd stage)

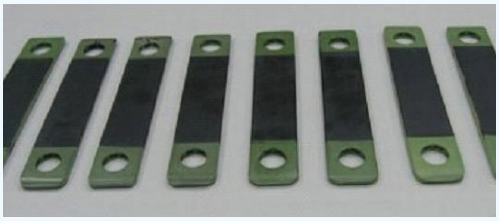
Patent		Theses							Proceedings		
		domestic			foreign			total sum			
domestic	foreign	SCI	Non SCI	sum	SCI	Non SCI	sum		domestic	foreign	sum
4/5			6	6	5		5	11	25	24	49

- Publications

1. J.H. Yu, S.K. Woo, I.S. Han, K.S. Hong, D.W. Seo, S.Y. Kim, "Solid Oxide Fuel Cell Stack", Korea Patent 10-2008-0131314, 2008.
2. J.H. Yu, S.K. Woo, I.S. Han, K.S. Hong, D.W. Seo, S.Y. Kim, "Tubular Solid Oxide Fuel Cell", US Patent 12368422, 2009.



Design compact ceramic stack


Close-end type of steam electrolysis cell