KOREA INSTITUTE OF ENERGY RESEARCH

CONCEPT PAPER

for KIER International Cooperation project

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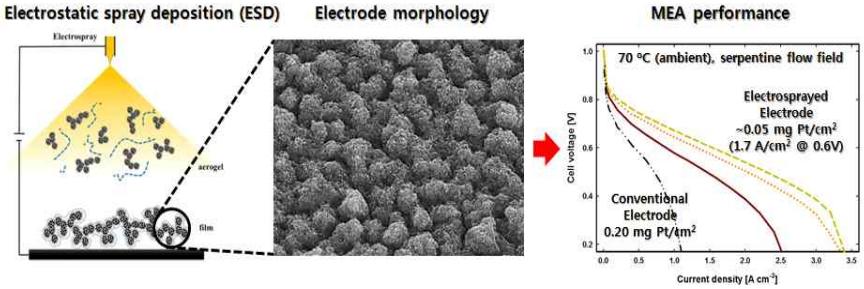
Title	**Associated development of high permeable PEMFC electrode with ultralow-Pt loading**			

Description

- **Background**

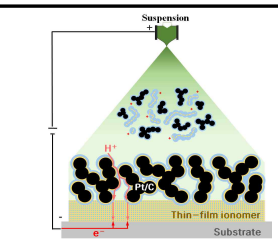
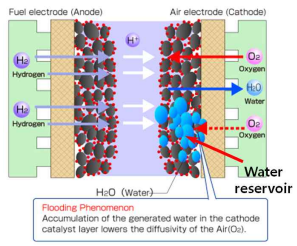
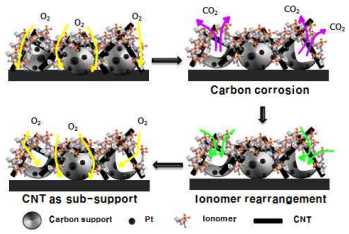
Preliminary results

√ **KIER & Nanyang Technological University (NTU) : Increase in electrical repulsive interaction among ionomers by electrostatic spray deposition (ESD) → Homogeneous distribution of ionomer on Pt/C → Reduced O_2 transport resistance through ionomer → Improved fuel cell performance**



√ **Problems : Complexity of fabrication process, scale-up and unperformed durability test**

- **Strategies**

	**Simplification of fabrication method (~2nd year) : KIER & NTU** **(Problem)** Complex-structured substrate is being used to realize the vertical structure → **(Solution)** Use of ultrathin ionomer layer as substrate → Solve the electrical interference issue of Pt/C and ionomer → Realization of the catalyst layer with enlarged electrode area (>200 cm^2)
	**Fuel cell performance (1st year) : KIER** **(Problem)** Well-known issue for thin-film catalyst layer → Severe water flooding → **(Solution)** Optimization of the catalyst layer thickness → Increased void volume for water reservoir → Improved O_2 transport → Enhanced fuel cell performance (1.7 → 2.5 A/cm^2)
	**Fuel cell durability (2nd year) : KIER** **(Problem)** Adhesion issue during wet-dry cycle & severe carbon corrosion for low-Pt-loaded catalyst layer → **(Solution)** Use of the carbon nanotube (CNT) as additives to prevent substrate collapse → Prevention of the ionomer rearrangement phenomenon on Pt/C → Enhanced fuel cell durability (< 10% degradation after durability test)

	● **Outlook :** **1) Fuel cell performance :** Performance improvement due to the facilitated O_2 transport (1.7 → 2.5 A/cm^2) **2) Fuel cell durability :** Durability improvement due to the prevention of substrate collapse (<10% degradation after durability test) **3) Platinum loading :** Reduction of Pt mass loading below 1/10 of the conventional electrode attributed to improved Pt surface utilization → 35% reduced cost for MEA fabrication **4) Development of core technology for low-Pt-loaded MEA and promotion of technology transfer**
Outcomes*	● **Targets** **1) Fuel cell performance** : 2.5 A/cm^2 @ 0.6V, 70^{o}C, ambient, serpentine flow field **2) Fuel cell durability** : 10% degradation after durability test (DOE protocol) **3) Platinum loading** : 0.125 mg_{Pt}/cm^2 (0.025 mg_{Pt}/cm^2 anode & 0.1 mg_{Pt}/cm^2 cathode) ● **Publications and/or Patents** **1) 3 SCI journal articles (IF > 7) and 2 US patents application (core technology) within 2 years**