SOC (Solid Oxide Cell) Project for Distributed Hydrogen Power with Sustainability

HYDROGEN

MiCoPower

MiCo Group is the group of global engineering companies starting from semiconductor sector and expanding its business portfolio to energy sectors



MiCoPower became the only Korean company retaining own core technologies and production lines of full-cycle process from cell, stack to system



✓ MiCoPower, the SOC first mover, has driven by the top leaders' noble will and the R&D activities of experts for the sustainability of clean H₂ energy



Taehyung Ha

Vice Chairman & CEO

2021 ~ Present: CEO, MiCoPower 2011 ~ 2021 : Professor, Finance, Suwon University 2016 ~ 2019 : Director, Yulchon Law Firm 2014 ~ 2016 : Director, Hyundai Economic Research Institute 2012 ~ 2014 : Advisor, Financial Supervisory Service *Ph.D, Economics, State University of New York*



Songho Choi

Vice President, COO

2021 ~ Present: COO (Vice President), MiCoPower
1999 ~ 2021 : Director, MiCo
2023 ~ : Vice president of the Korean hydrogen & new energy society
2023 ~ : Vice president of the Korean ceramic society
2021 ~ : Subdivision committee member of Korea gas safety code board (MOTIE)
Ph.D, Materials S&E, Georgia Tech (USA)



Daero Jeong

Director, CFO

2021 ~ Present : CFO, MiCoPower 2016 ~ 2021 : Mirae Asset Daewoo Research Center 2007 ~ 2016 : Daewoo Securities Research Center *BA, Business Administration, Korea University*



Jinah Park

Director, CTO / Head of Production

2021 ~ Present : Director, MiCoPower 2011 ~ 2020 : Team Leader, MiCo 2010 ~ 2011 : Research Assistant Professor, MSE, POSTECH 2007 ~ 2010 : ETRI Post-Doc 2023 ~ : Hydrogen committee member of Seoul Metropolitan Government *Ph.D, Electrical Engineering, Dong-Eui University*



Shinku Lee

Leader of System R&D

2022 ~ Present : Team Leader, MiCoPower 2020 ~ 2022 : CTO, HN Power Co., Ltd 2019 ~ 2020 : Senior Researcher, Doosan Fuel Cell 2014 ~ 2018 : Senior Researcher, Doosan Heavy Industries 2023 ~ : Committee member of Korea electrical safety board (MOTIE) *Ph.D, Mechanical Engineering, KAIST*



Jinsoo Park

Leader of Stack R&D

2022 ~ Present : Team Leader, MiCoPower 2012 ~ 2016 : Director, EXEN Co., Ltd 2008 ~ 2011 : CEO, SIOS Co., Ltd *Ph.D, Materials S&E, KAIST*

SOC Technology

✓ SOC (Solid Oxide Cell) = SOFC (Fuel Cell) + SOEC (Electrolysis Cell), it will be playing a key role in the energy paradigm shift due to its flexibility

- **SOFC** Combined heat & power system with the electrochemical reaction of hydrogen (fuel) and oxygen (air)
- SOEC Efficient green hydrogen production system with the electrolysis reaction of electricity and steam (water)
- * Non-combustion power generators with no emission of SOx, NOx, and dust



Role of SOFC		Fossil Fuel Society	Transition	Hydrogen Society
Fuel		Natural Gas	Blue Hydrogen	Green Hydrogen
Carbon Reduction	Electrical	NG based highly efficient power generation Biogas fueled Power, WTE	Blue hydrogen based SOFC NG SOFC + CCU	Production of green H ₂ (SOEC) Green H ₂ Power Generation (SOFC)
	Thermal	Efficient utilization of the heat on sites		

✓ SOFC and SOEC are systems providing the best efficiency in stationary applications among all types and they are reversible

Fuel Cell

	PAFC	MCFC	PEMFC	SOFC
Electrolyte	Phosphoric acid	Molten carbonate	Polymer	Ceramics
Temperature	~ 200°C	600 ~ 700°C	~ 80°C	650 ~ 800°C
Fuel	H ₂	Н ₂ , СО	H ₂	H ₂ , CO
Efficiency	~ 43%	~ 47%	~ 40%	60% ~

Electrolysis Cell

	AWE	PEMWE	SOEC
Temperature	60 ~ 90	50 ~ 80	700 ~ 900
Efficiency	51 ~ 60	46 ~ 60	> 80



✓ We have rapidly achieved advanced SOC core technologies and will be competitive with expandable business in emerging global hydrogen market

Global Climate Technology	 Strong government policy-making for FC and hydrogen market in Korea New & renewable portfolio standard for urban buildings (US\$ 100M ~) Launching of Clean Hydrogen Energy Portfolio Standards (US\$ 3 ~ 4B in 2028) Special action on the Promotion of Distributed Energy (2023), Hydrogen Roadmap (2023, hydrogen mobility/power/production/delivery) Hydrogen fuel cell market expected to reach US\$ 131B by 2030 with CAGR 60.1% (Precedence Search) Emerging Hydrogen global green hydrogen market US\$ 332B by 2032 with CAGR 54.9% Korea Hydrogen Roadmap (2023) targeting 2.8\$/kg in 2030, US Energy Earth Shot Initiative (2021) targeting 1\$/kg in 1 decade Strong support from our top tier investors including KDB for global market growth of climate technology
Technology Superiority	 The only company with SOC core technologies of cell, stack, system in Korea The only SOFC stack manufacturing line (2MW/yr) with KS/KGS certified quality management system in Korea Planned and confirmed new factory expansion (potentially ~ 30MW) Professional and continuous SOC R&D over a decade based on government funded projects Systematic IP registration and strategic analysis through IP R&D for core technologies (88 patents) Fast R&D of large scale FC (150kW) and EC (600kWe) system with our own stacks by professional and experienced engineers
Market Competitiveness	 The first KS/KGS/NEP certified SOFC systems (2k/8k) for faster market entry in Korea Market transition from PEM to SOFC in urban DG market due to the best efficiency improving users' benefits Launching public market entry with exclusive public contract in 2023(qualified to the best product) Designed to install our systems in private urban market Competitive product commercialization with various models (2k, 8k, backup power, biogas fueled, green H₂ fueled) Expectation of global market penetration to distributed FC power and hydrogen production with EC Cost effective stack supply with automated mass production based on own technology

SOC Business Vision

✓ Various systems based on own technology will be released, reflecting fuel infrastructure, trend of policy, and social needs for carbon neutral

Ceramics to Hydrogen Energy

MiCoPower



Technical Strategy

✓ Achievement of stack module technology and manufacturing facility will expedite system scale-up and highly applicable system release



 \checkmark Automated mass production line for cost effectiveness of stacks will continuously expanded along with market trend (2MW/yr \rightarrow ~ 50MW/yr)





✓ World class high efficiency for SOFC system has been achieved and will be applied to large scale FC and EC system



TUCY 2kW SOFC System

Since it has a constant power generation efficiency of 50% or more and an operation rate of 90% or more, it is possible to secure the economic feasibility of operating the building market Maximize consumer benefits and contribute to minimizing carbon generation from buildings by applying various heat utilization measures such as hot water, air conditioning, and dehumidification







✓ World class high efficiency for SOFC system has been achieved and will be applied to large scale FC and EC system



RTUCY 8kW SOFC System

System design technology for world class electrical efficiency : 63% (best in Korea)

Market expansion (Phase I) and track recording of commercial 8kW systems in urban FC market Planning to apply the technology for high efficiency of 150kW system for DG market (Phase II)





600kWe class SOEC system will be developed and released in the combination with hydrogen FC for leading the market transition to green hydrogen society

Ceramics to Hydrogen Energy

MiCoPower



THANK YOU



MiCoPower Ceramics to Hydrogen Energy