ICGA2026

THE 4TH INTERNATIONAL CONFERENCE ON GREEN AVIATION

北京航空航天大學 BEIHANG UNIVERSITY

High-Performance Lightweight Fuel Cells for Aviation From Materials to Equipment



Yan Xiang, Ph.D.

Chair Prof. RSC Fellow

Founder of SENOHERS

xiangy@buaa.edu.cn

Beihang University

School of Energy and Power Engineering

November 03, 2026. Xi'an

The Team

北京航空航天大學
BEIHANG UNIVERSITY

R & D team

仿生能源材料与器件北京市重点实验室
Beijing Key Laboratory of Bio-inspired Energy Materials and Devices

Research focus

Energy Conversion Electrochemistry and Engineering



- Hydrogen energy and fuel cell tech.
- Fluid battery and related materials
- Electrochemisty solutions for environment protection

Team Members



Yan Xiang
Director
RSC fellow
SAE Committee



Shanfu Lu
Duputy Director



Haining Wang



Jin Zhang



Yunqi Li



Yiyang Liu

Achievement

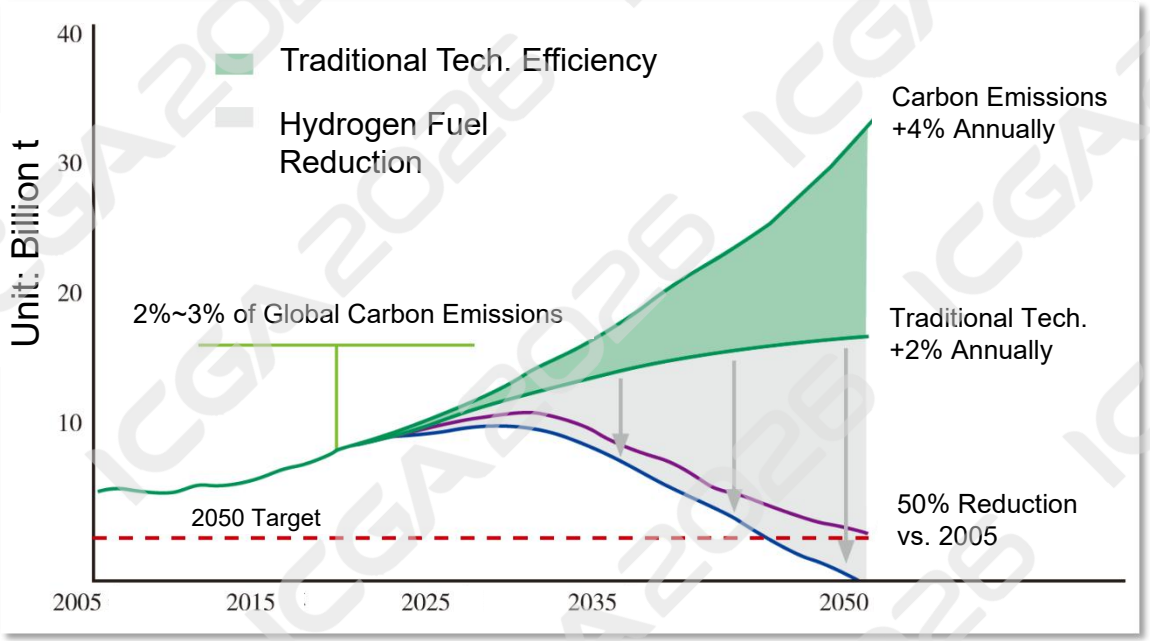
- PIs of 50 key projects from MOST, NSFC etc.
- 300 publications in related area
- Innovation Award of China Energy Research Society
- Innovation Award of National Entrepreneurship, Suzho
- Aard of Excellent, The 9th Dongsheng Cup for Entrepreneurship



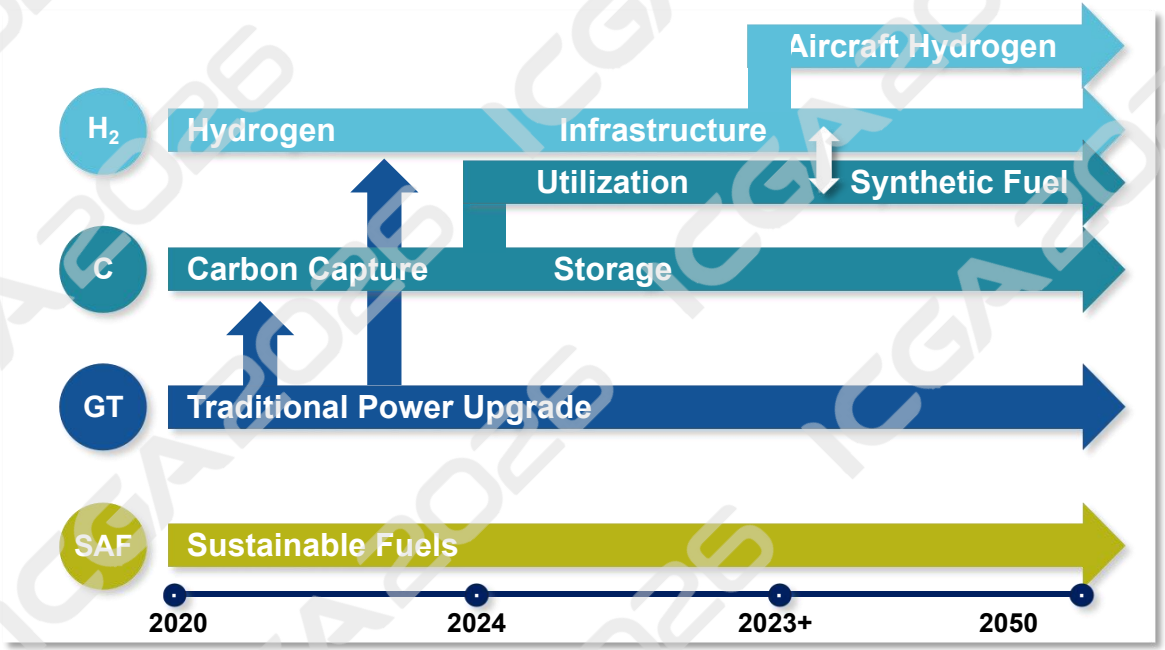
Green energy is the key to green aviation

北京航空航天大學 BEIHANG UNIVERSITY

- Facing climate challenges, aviation faces immense emission reduction pressure.
- SAF and hydrogen aviation are key to zero-emission and sustainable development.



Aviation Carbon Emission Trends (Source: ICAO)



Aviation Carbon Neutrality Roadmap (Source: Airbus)

Green energy is key. Current transition relies on SAF; hydrogen is the future direction.

Top-level Roadmaps for Hydrogen Aviation Worldwide



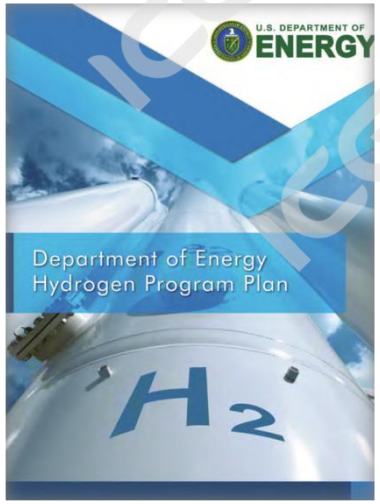
◆ 2020 EU "Hydrogen-powered Aviation "

- 4 areas: core H_2 components, H_2 aircraft systems, infrastructure barriers, governance framework
- **2028:** Commuter Aircraft Certification
- **2035:** Medium-haul Aircraft
- **2050:** Med/Long-range Prototype



◆ 2021 UK "National Hydrogen Strategy "

- Lead globally by 2030 with 5GW low-carbon H_2 capacity
- **2024:** Electrolytic H_2, Aviation Trials
- **2027:** Scale up H_2 Production & Storage
- **2030:** Large-scale H_2 Dev. & Aviation Use



◆ 2020 US "Hydrogen Program Plan "

- 10+ years R&D framework; study fuel cells & gas turbines
- **2025:** $7B funding for H2 & FC key tech (National Labs)



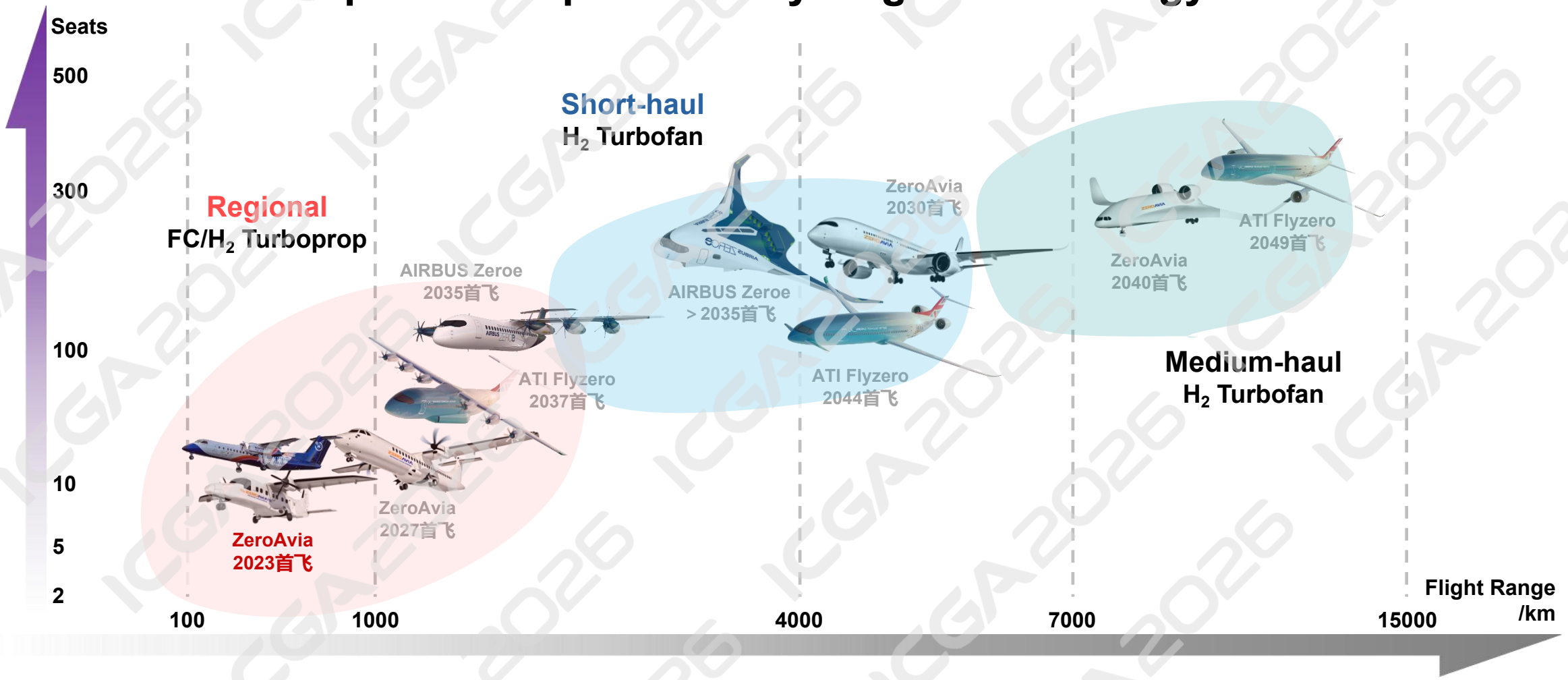
◆ 2023 China "Green Aviation Mfg. Development Outline"

- Focus areas: Green+, Electric & Hydrogen Aviation
- **Accelerate H_2 storage & power tech; research new structures for H2 aircraft**

Multiple Proposals from Aviation Giants and Startups

北京航空航天大學 BEIHANG UNIVERSITY

Rapid Development of Hydrogen Technology



Over past decade, aviation companies have researched H_2 aviation and established initial proposals. In 2023, 2 FC regional aircraft achieved maiden flight (Universal Hydrogen, ZeroAvia).

Hydrogen Aviation Power Technology Paths

北京航空航天大學 BEIHANG UNIVERSITY

	Reduction in climate impact			Scalability	Net Impact	Key challenges
	Direct CO2	NOx	Water vapour & contrails			
H2-electric	●	●	◔	●	◉	Weight of the powertrain; Higher volume fuel tanks required
H2 combustion	●	●	●	●	◧	Higher non-CO2 climate impact than fossil fuels; Even higher volume fuel tanks required
Sustainable aviation fuels	●	●	◔	●	◔	Bio feedstock sustainability; High cost of synthetic fuels Same in-flight emissions
Battery electric	●	●	●	●	◧	Weight of battery precludes large aircraft; Frequent replacement
Hybrid-electric	◧	◔	◔	●	◧	Small incremental impact (10-20% max) on both economics and climate

● Comprehensive ● Moderate ● Limited

Two main paths: Fuel Cells and H_2 Engines

Application of Hydrogen Energy in Aviation

北京航空航天大學 BEIHANG UNIVERSITY

◆ US ZeroAvia Dornier 228 Propeller Aircraft



Seating: **19**
Power: Hydrogen Fuel Cell
10-min test flight completed in Jan 2023 first trail
2026 Airworthiness

◆ UK Aerospace Tech Inst. FlyZero Propeller Aircraft



Seating: **75**
Power: Hydrogen Fuel Cell
Planned commercialization before 2035
Closed

◆ European Airbus Zeroe Aircraft



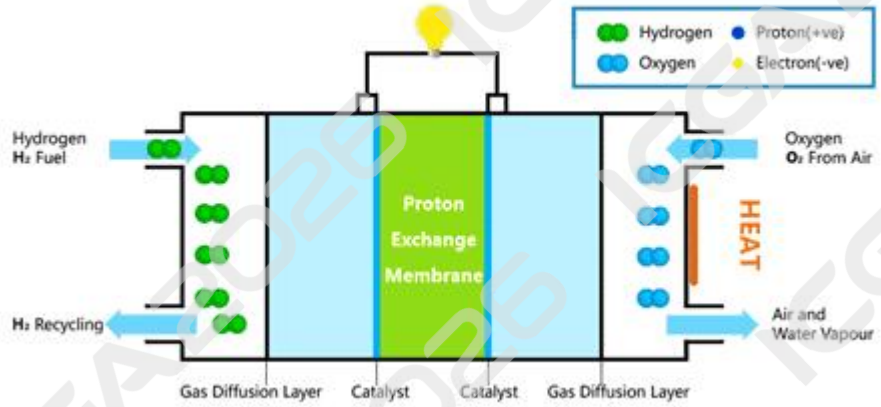
Seating: **90**
Power: Hydrogen Hybrid (Turbine + Fuel Cell)
Engine selection planned for 2023
2026: 2MW ground testing

◆ US Universal Hydrogen Dash 8 Propeller Aircraft

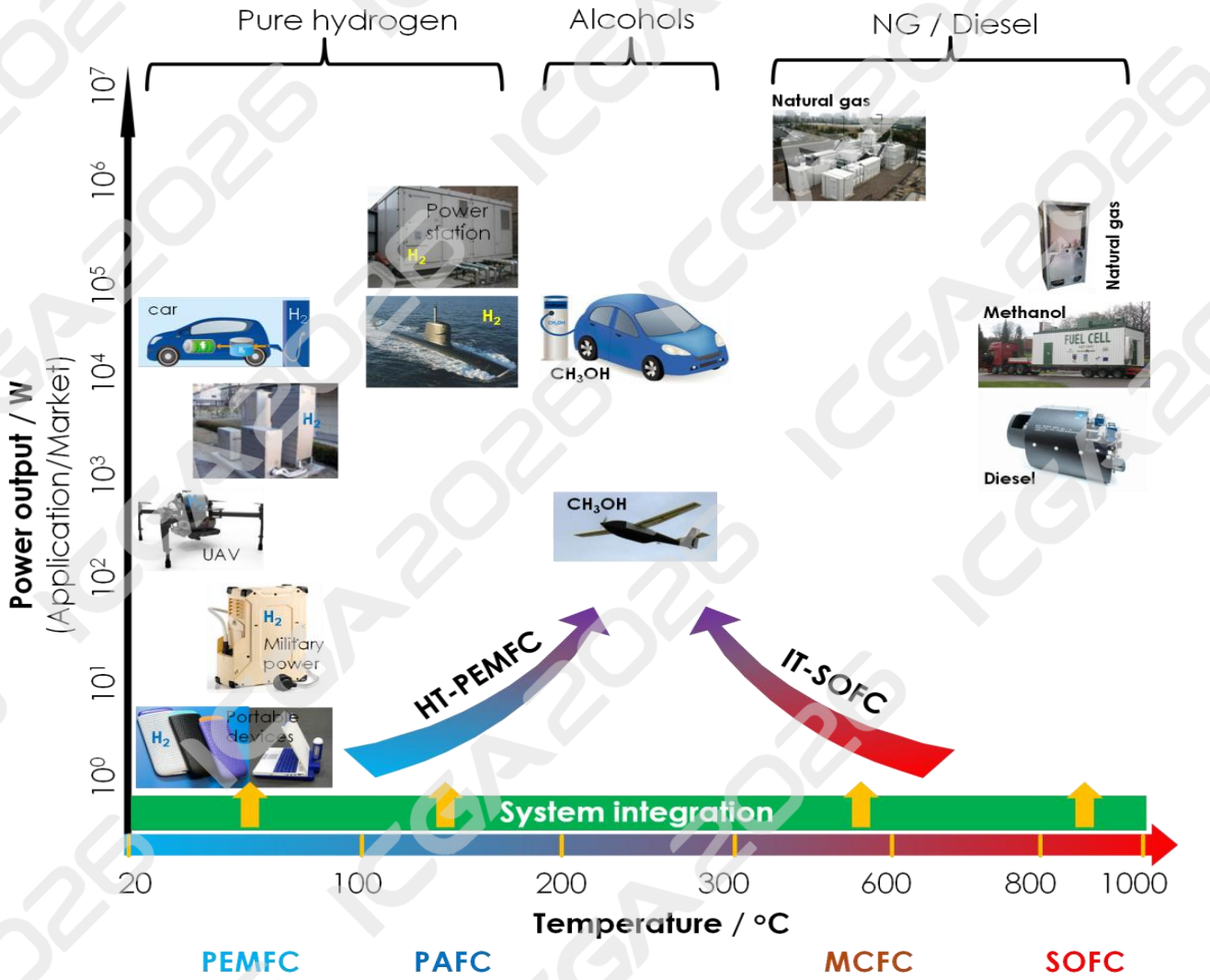


Seating: **40-50**
Power: Hydrogen Fuel Cell
First flight completed in Mar 2023, range 333km, duration 1 hour
Bankrupted

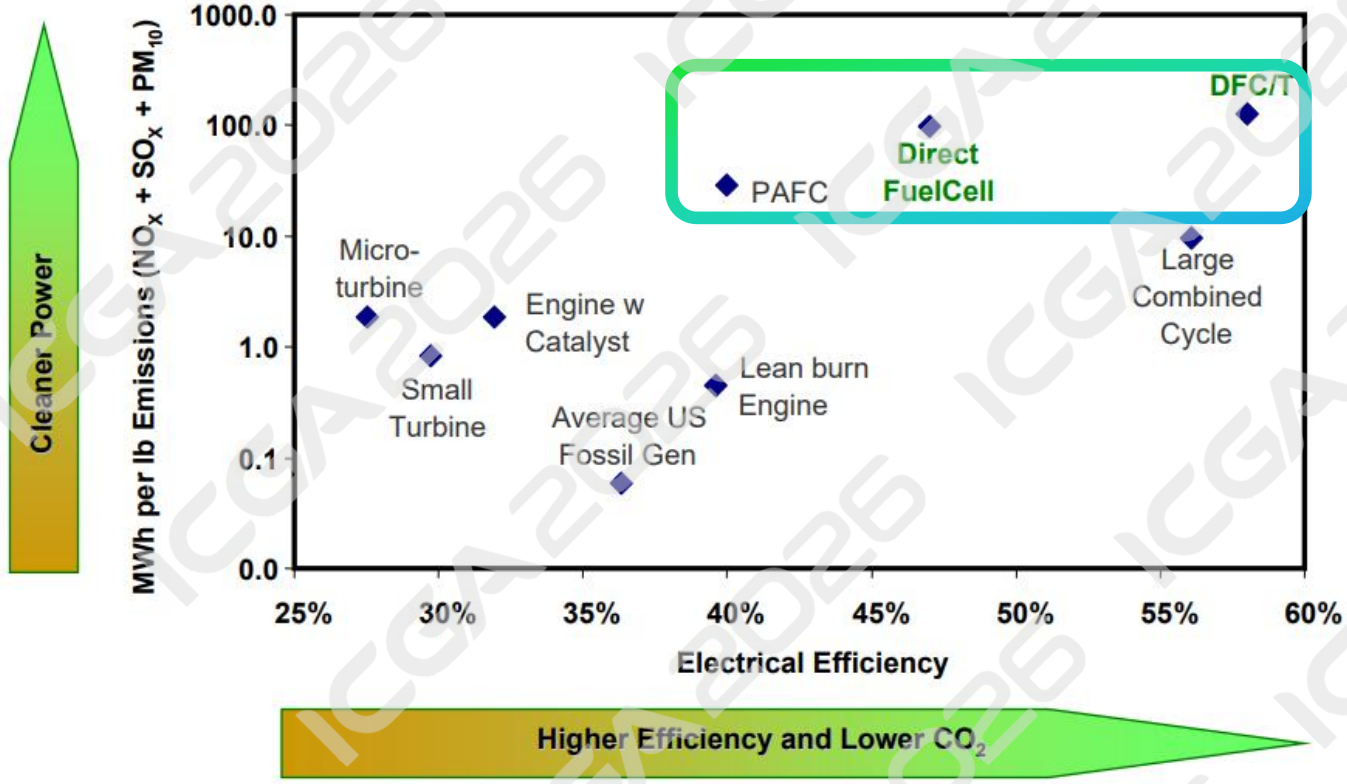
Fuel Cell Classification & Fuel Selection

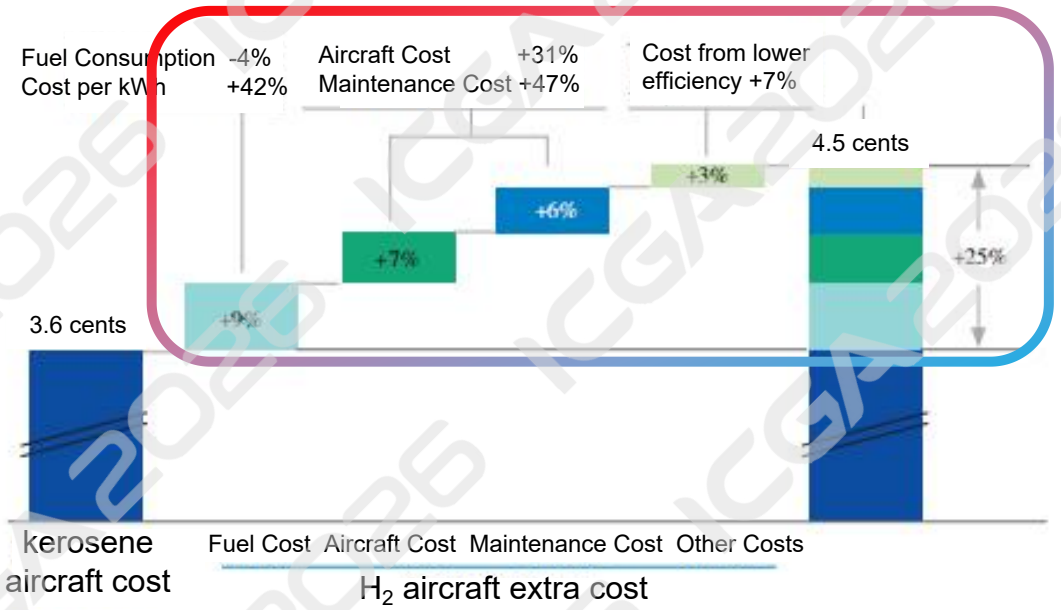


Tech. Path	Temp (℃)	Power Output	Fuel Source
LT-FC	<100	5W~MW	Pure (Liquid) H_2
MT-FC	100~300	10W~100kW	Methanol
HT-FC	400~1000	kW~MW	LNG, Diesel, Methanol, etc.



Fuel Power Efficiency and Cost Comparison





2040 short-haul 2000km, 165-seat H_2 aircraft cost (per pax/km)

High Temp. **Phosphoric Acid Fuel Cell**
Direct Fuel Cell: LNG, Quinone, Alcohol, SAF, etc.

H_2 aircraft extra cost is huge; low-cost fuel is crucial.

Liquid Hydrogen Sources in Aviation

北京航空航天大學 BEIHANG UNIVERSITY

Common Issues of H_2

Low volumetric energy density: 1/8 of aviation fuel (70 MPa)

Difficult liquefaction & storage: -253℃, insulation tech.

Low safety: regulations & certification issues

Material compatibility: H_2-induced metal embrittlement

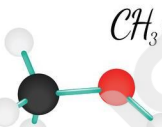
High infrastructure cost: storage, transport, distribution



Liquid Hydrogen Source Tech



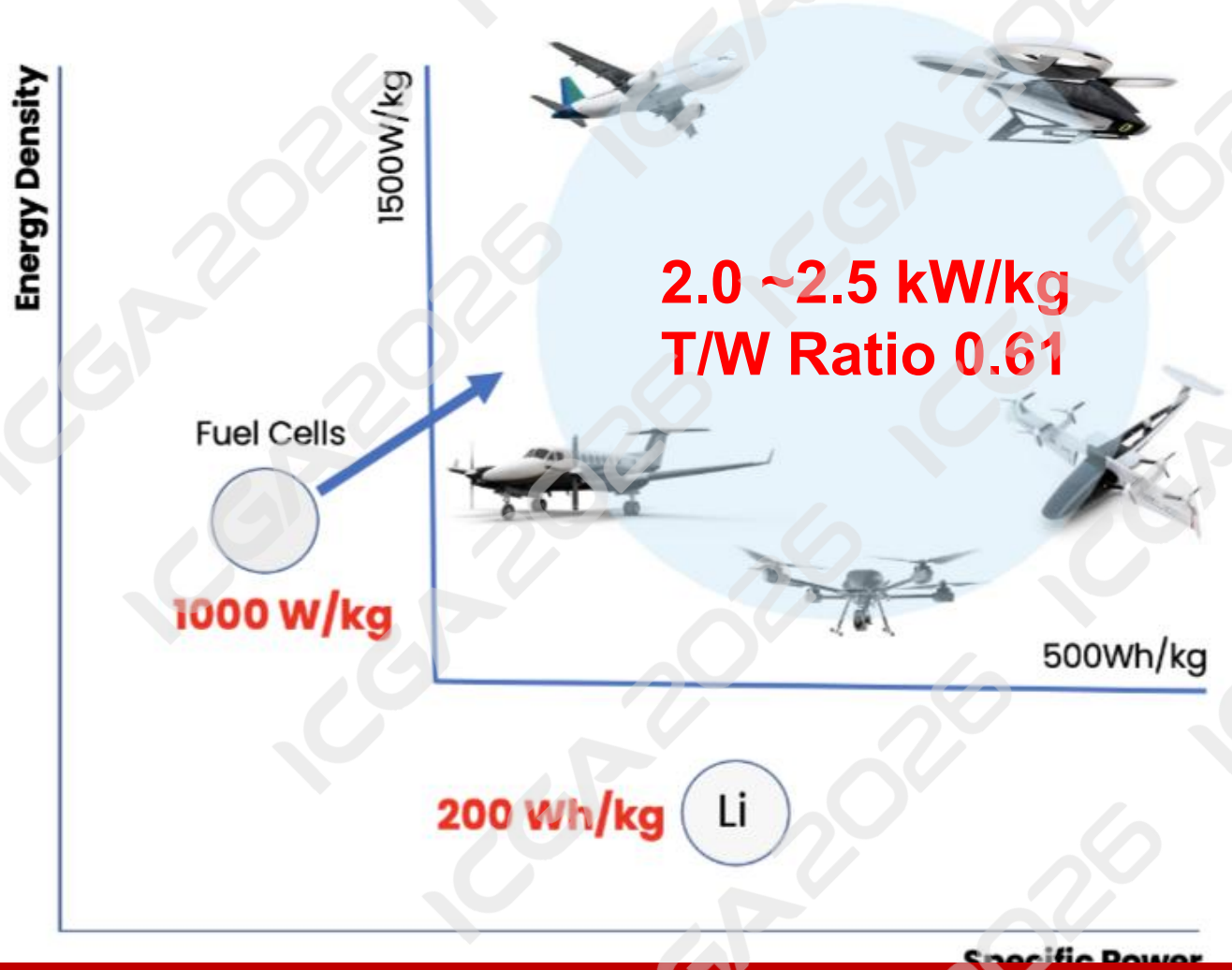
- ✓ Room temp & pressure liquid H_2 storage 18.75%
- ✓ Produce & use on-site; mild H_2 release conditions
- ✓ Helps carbon sequestration



liquid sunshine 液态阳光

H_2 Storage Method	Grav. (kWh/kg)	Vol. (kWh/L)	Emissions (kg CO_2/kWh)	Explosion Risk	Compatibility	Infracost
Comp. H_2 (70MPa)	33.6	1.3	0	High	metal embrittlement	High
Liq. H_2 (-253°C)	33.6	2.4	0	High	metal embrittlement	High
LNG (-162°C)	~14.0	~6.0	0.20	High	Good	Low
Liq. NH_3 (-33°C)	6.0	4.1	0	Low	Good	Low
Methanol Sol.(Room Temp & Pressure)	4.8	4.3	0.18	Low	Good	Low

The Goals of Fuel Cell Tech in Aviation



- Aviation requirement for FC Specific Power:

  1.5 kW/kg+

- Current industry level: 1000 W/kg

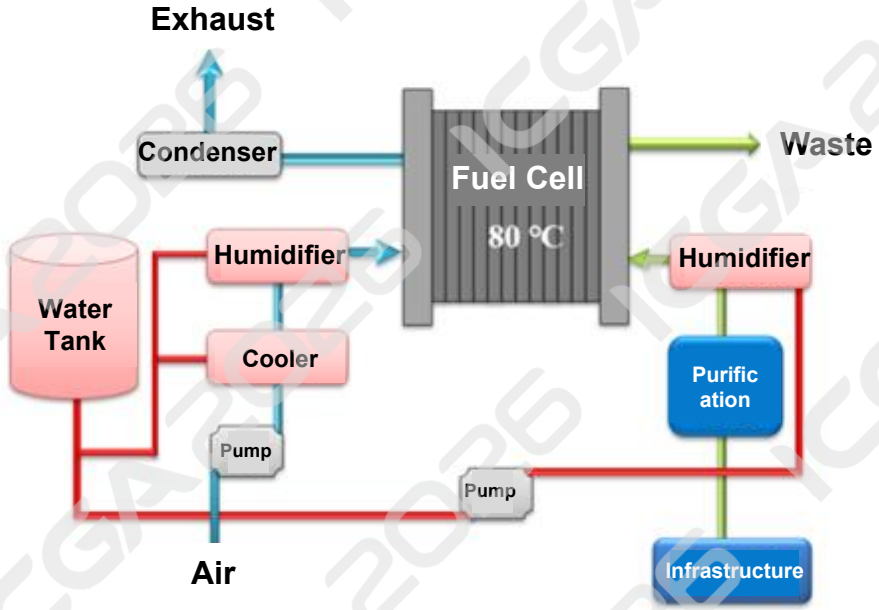
- Applications: small propulsion & UAV power

Impossible Mission? !

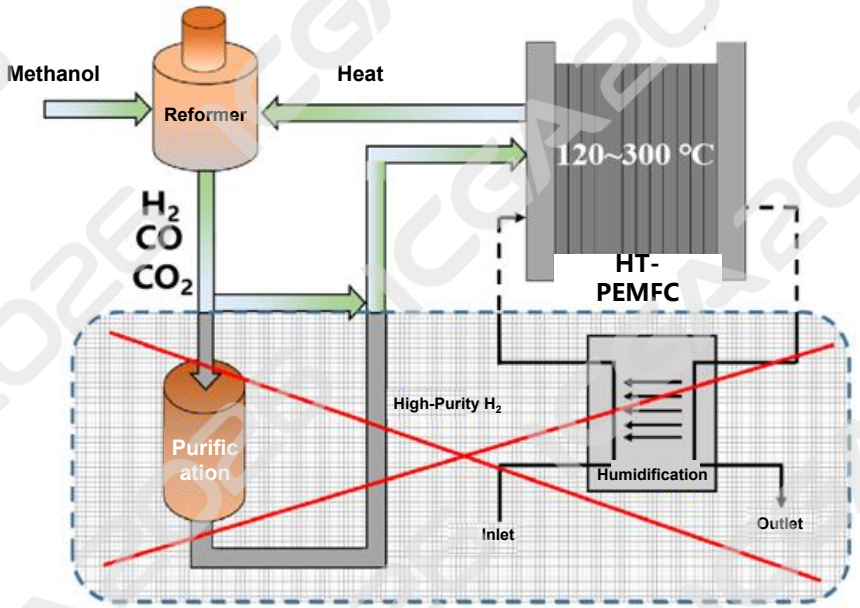
HT-PEMFC Technology

北京航空航天大學 BEIHANG UNIVERSITY

LT-PEMFC 80°C) TRL 9~10



HT-PEMFC(120~200°C) TRL 6~7



- High H_2 purity requirement, poor impurity tolerance
- Complex water & thermal management
- High power density
- Fast start-up

- Compatible with industrial byproduct H_2 & reformate
- Simplified water & thermal management
- High overall efficiency 90%+: Electricity + heat + Cold
- Slow low-temp start-up

- Japan NEDO2040 "Fuel Cell Roadmap for Automobiles and Heavy-Duty Trucks" and "Stationary Fuel Cell Roadmap "
- MOST Major Research Plan

H_2 Aviation Fuel Cell Tech Indicator Forecast

北京航空航天大學 BEIHANG UNIVERSITY

ATI UK	Year	2026	2030	2035	2050
LT-PEM Fuel Cell	LT-PEM Stack P/W Ratio(kW/kg)	7	9	11	16
	LT-PEM Stack & BOP P/W Ratio(kW/kg)	1.5~2.0	2.0~2.5	2.5~3.0	3.0~3.5
	Max Stack Efficiency(%)	60	65	70	75
	Durability Target(h)	5000	10000	15000	25000
	Operating Temp(°C)	80	90	100	100
	Stack Cost ($/kW)	920	600	320	160
	System Cost ($/kW)	1560	1100	640	500
HT-PEM Fuel Cell	HT-PEM Stack P/W Ratio (kW/kg)	≤ 1	≤ 3	≤ 5	16
	HT-PEM Stack & BOP P/W Ratio (kW/kg)	0.5	1.5~2.0	2.5~3.0	5.0~6.0
	Operating Temp (°C)	160	120	160	≥ 160

Aeroengine, 2023 (5) 31~35

Example: Hypoint & ZeroAvia



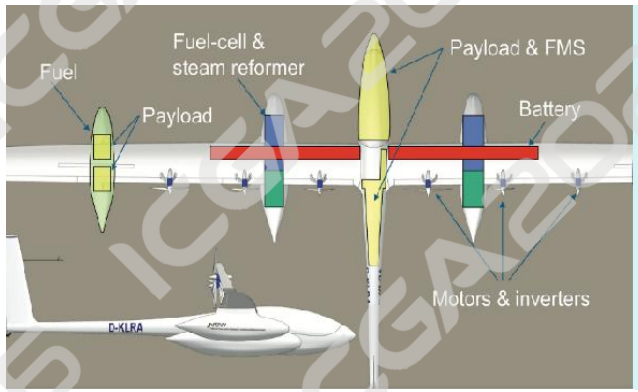
HyPoint HTPEMFC System Structure



German Lange Aviation
Antares E2 Surveillance UAV



HyPoint HTPEMFC System 3D Demo



Takeoff weight 1650kg
Max payload 200kg
Fuel tank 300kg methanol
Endurance 40 hours
Fuel cell 6x6.7 kW

Is it achievable?

Piasecki & Zeroavia Jointly Develop PA-890 eVTOL Fuel Cell Powered Helicopter

Validation Platform

EDM Aerotec CoAX 2D Twin-Seat Coaxial Helicopter Modification Platform

Fuel Cell System

Adopts high-temp PEM fuel cell system, ~80kW class, followed by ~660kW full-scale propulsion system

Propulsion Method

Electric propulsion, incl. motor, inverter & rotor drive system

Development Process

HAXEL Demonstrator

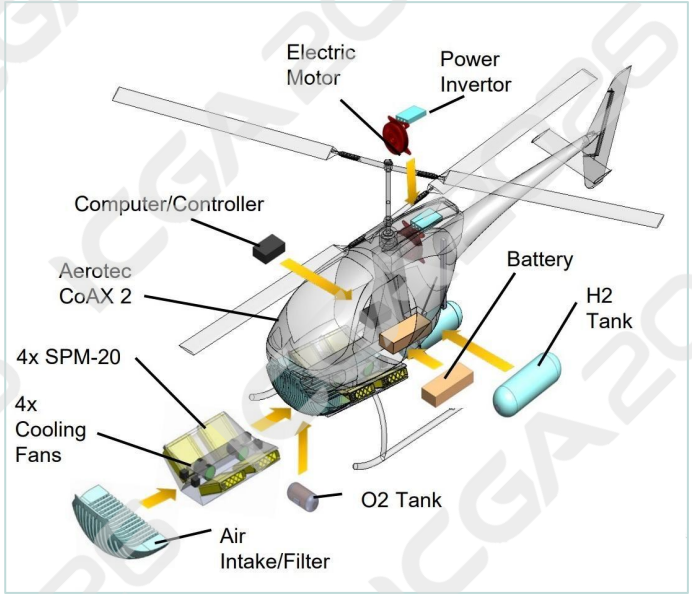
4×16 kW fuel cell + battery peak shaving + 210 kW motor, four 350 bar H2 tanks on fuselage.

660 kW Propulsion System

Modular stacking, left/right redundancy, fully packed into cabin space same size as turboshaft engine.

PA-890 Production Aircraft (Slow Rotor + Wing Compound)

7,000 lb MTOW, 1,660 lb payload, 200 nm range, certified under FAA Part 27.





Progress in HT-PEMFC tech. @BUAA

北京航空航天大學 BEIHANG UNIVERSITY

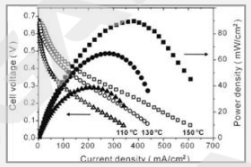
Key scientific issues
- PA loss at low temperature
- Proton transfer efficiency

Supported by Key R&D Programs, National Key Scientific Funds

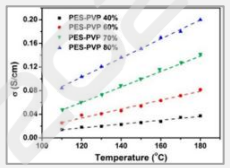
2010-2016 | 2011-2026 | 2019-2026 | 2022-2026

Basic Research → Applied Research → Engineering Research

HT-PEM



First paper
Adv. Mater. 2010



Conductivity
> 0.1S cm^{-1}

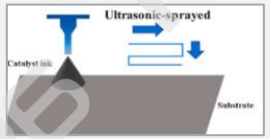


Mass preparation

ZL201910748699.2
ZL201910873513.6
ZL201010256732.9
ZL200910243704.0
ZL201410265801.0

Nat Energy, **2026**, 11,1043–1054.
Adv. Mater. 2024, 36, 2310584
Adv. Mater. 2010, 22, 971-976
Adv. Funct. Mater. 2023, 33, 2210036
Adv. Funct. Mater. 2023, 33, 2214097
Adv. Energy Mater. 2014, 4, 1400842

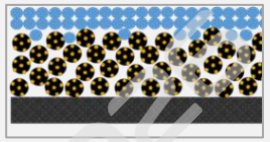
Catalyst layer



preparation process



Three-phase interface structure



Membrane-electrode interface

ZL202210648655.4
ZL202211396714.X
ZL201310593705.4
ZL201710888971.8
ZL201811227577.0

J. Power Sources, 2025, 645, 237178.
Chem. Eng. J. 2025, 518, 164518.
Chem. Eng. Sci. 2025, 302, 120830.
J. Mater. Chem. A 2015, 3, 8847;
J. Power Sources, 2015, 286, 458;
J. Mater. Chem. A 2016, 4, 1174;
J. Mater. Chem. A 2015, 3, 148;

MEA and stack



Large-size MEA





1kW 5kW stack



Coupling system of stack and methanol reformer

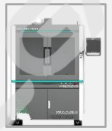
ZL202210648655.4
ZL202121073556
ZL201910124444.9.5

J. Membr. Sci. 2018, 558, 26;
Adv. Sustain. Syst. 2018, 2, 1700184
Int. J. Hydro Energy, 2018, 43, 22487.
J. Membr. Sci. 2019, 572, 496;
J. Membr. Sci. 2019, 592, 117395;
J. Power Sources 2019, 443, 227219;
J. Membr. Sci. 2023, 677, 121618;

System integration



5kW module



Test platform



CHP products



Scenario application

Adv. Funct. Mater. 2023, 33, 2210036
Adv. Funct. Mater. 2023, 33, 2214097
Adv. Mater. 2024, 2310584;
Int. J. Hydro Energy, 2025, 145, 548558.
Int. J. Hydro Energy, 2025, 166, 150971

CN202410917198 3
ZL202221695716.4
CN202310509915.4
CN202411202189.2
CN202411257801.6
CN202411512630.7
CN202510124725.X

HT-PEMFC Product System

北京航空航天大學 BEIHANG UNIVERSITY

SENOHERS 海得利兹



High-temperature proton exchange membrane

50000 m²/year



MEA

3000 m²/year



Stacks

1000 units/year



5kW Power generation system modules

800 sets/year



CHP Systems

500 sets/year



Testing Platforms

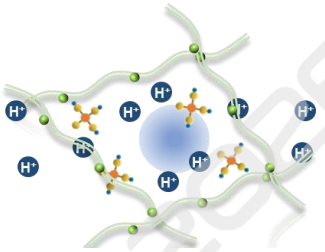
100 sets/year

- Selected for the first batch of Beijing Key New Material Application Demonstration Guidance Catalogue
- Mass production of high-temperature membrane fuel cell and methanol reforming fuel cell power generation systems
- Build the largest high-temperature membrane electrode production base in China
- Direct revenue of 40 Million Yuan

R &D Milestones of HT-PEMFC @BUAA

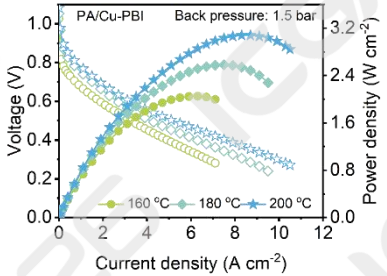
北京航空航天大學 BEIHANG UNIVERSITY

Technological Innovation



Synergistic effect of multiple proton conductors

40~180℃ wide temperature range operation



P_{max} breakthrough 3.1 W cm^{-2} (200°C)

The voltage decay rate decreases by 3 orders of magnitude

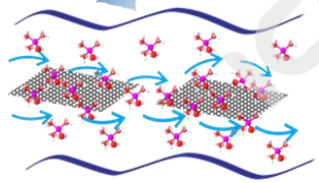
Technological innovation

Engineering

Materials innovation

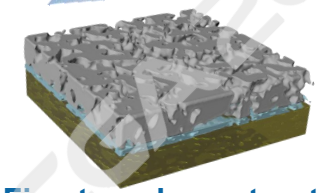
Performance breakthrough

Methods innovation



PA confined aggregation

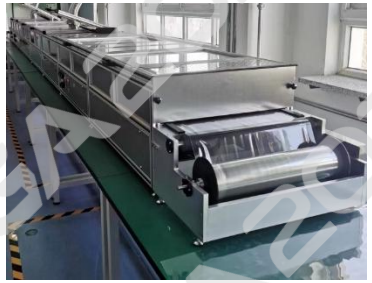
1 times higher conductivity, 7 times higher stability



Fine tuned construction of MEA

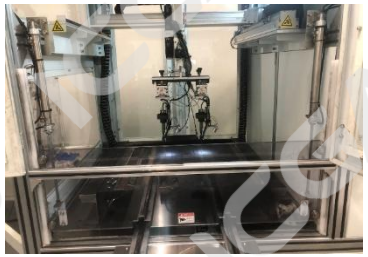
Voltage consistency deviation < 10 mV@ 33A

Engineering Batch Production





Fully self-produced HT-PEM with an annual production capacity of 50000 m^2





Batch preparation of large-sized HT MEA with an annual production capacity of 10^5 pieces



5kW HT-PEM stack



Methanol reforming fuel cell system

Demonstration Application



Hers-P5 Base station power supply



Hers-C20 combined heat and power (CHP) technology



Hers-C30 Zero-carbon park CHP



FL001 Methanol reforming extended range power forklift



Hers-C5 Agricultural CHP



250Nm^3 Methanol hydrogen production equipment

Methanol Reforming FC Power Sys

北京航空航天大學 BEIHANG UNIVERSITY

Excellent Power System Performance

System efficiency:42.9%
Overall EE: 90.9%
Operating Tem: -20~55℃

检 验 报 告

报告编号：	KOT20240614066C
产品名称：	5kW甲醇重整高温燃料电池发电系统
商　　标：	PPtec
型　　号：	Hers-P5
申 请 商：	北京海得利兹新技术有限公司
地　　址：	北京市大兴区魏永路（天堂河段）70号院3号楼四层406室
检验类别：	委托检验

深圳市凯欧检测技术有限公司

深圳市宝安区福海街道风塘大道讯源智创谷工业园 1 栋 7 楼

电话:0755-23307694

网址：www.kot-lab.com

整机正面照片



出口水平均温度（K）	343.5
入口水平均温度（K）	298.5
水平均体积流速（m^3/s）	2.26×10^{-5}
出口水的密度（kg/m^3）	1000
平均燃料流速（m^3/s）	5.69×10^{-7}
平均回收热能（kJ/s）	4.24
平均燃料能量输入(kJ/s)	8.84
电效率（%）	42.9
热回收效率（%）	48
总能量效率（%）	90.9

New Technology & Product Certificate



北京市新技术新产品（服务）证书

单位名称：北京海得利兹新技术有限公司　　证书编号：XCP2023NM0141

新产品名称：高温膜燃料电池发电系统　　发证日期：2023年12月

产品型号：PPtec-5000　　有效期：3年

批准机关：

北京市科学技术委员会　中关村科技园区管理委员会（北京市科学技术委员会代章）　北京市发展和改革委员会　北京市经济和信息化局　北京市住房和城乡建设委员会　北京市市场监督管理局

Beijing New Tech/Product (Service) Certificate

Beijing Energy-Saving Tech/Product Recommendation Catalog (New & Renewable Energy Category)

Typical Applications

北京航空航天大學 BEIHANG UNIVERSITY

Base Station Power



Beijing Mobile

用户使用证明

我公司于 2024 年 3 月 25 日在北京海得利兹新技术有限公司采购 5 套 Heracles-05 高温膜燃料电池发电系统（单套功率 5kW），用于移动运营商通信基站安装。该系统采用先进的设计理念和技术，现运行效果良好，满足基站的供电需求和各项防护要求。

该公司工程师服务热情，电话 24 小时在线，售后服务响应及时。

The system adopts advanced design concepts and technology, operates well, and meets the power supply and protection requirements of the base station.

北京动力老能源科技有限公司

2024 年 9 月 20 日

User Certificate

Combined Heat & Power





CHP Demonstration Project

用户使用证明

我公司于 2024 年 1 月使用了北京海得利兹新技术有限公司开发的“甲醇重整高温膜燃料电池热电联供系统”，为老宋瓜王 4 号棚西瓜育苗提供部分热能和电能，该系统于 2024 年 1 月投入运行以来，运行状态良好，符合应用要求。

Running well, meets application requirements.

北京老宋瓜王科技发展有限公司

2024 年 3 月 1 日

User Certificate

Emergency Power: Miyun Flood Relief Power Supply

用户使用证明

我单位于 2025 年 8 月 2 日至 4 日，在防汛救灾过程中使用了北京海得利兹新技术有限公司所提供的甲醇重整高温膜燃料电池发电系统，作为应急发电电源。该系统于密云区北庄镇营房村和杨家堡村两个临时安置点，为受灾群众进行紧急供电。

在此期间，该发电系统能够长时间保持稳定且静音地发电，为安置点受灾群众提供了安全可靠的生活用电保障。该系统启动迅速，对环境与地理条件要求较低，可以灵活安置。其所使用的液态燃料便于存储，自动化程度高，运行过程平稳，满足受灾群众用电需求。

Maintains stable and quiet power generation for a long time, providing safe and reliable living power for the victims.

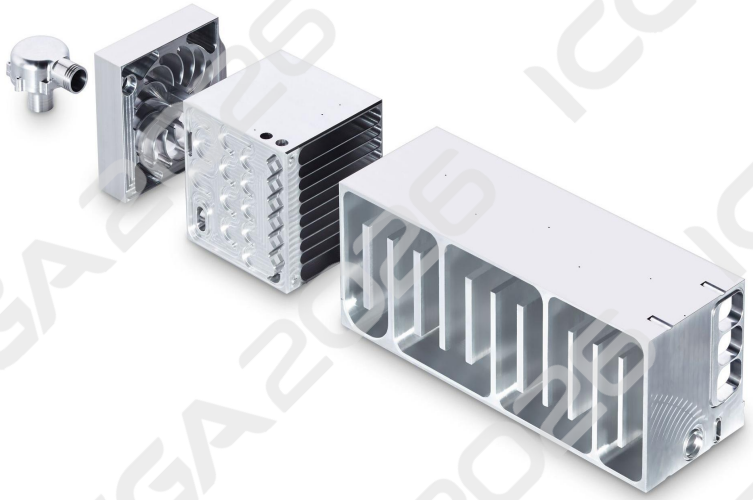
北京市密云区北庄镇人民政府

2025 年 8 月 21 日

Research Foundation

北京航空航天大學 BEIHANG UNIVERSITY

Stack Design for Reformer Design, Development, Verification and Testing





30kW Methanol Reforming HT-PEMFC System Design & Application



30kW System Application at Beijing Daxing Int'l Hydrogen Zone



30kW System Application at Yixian, Hebei

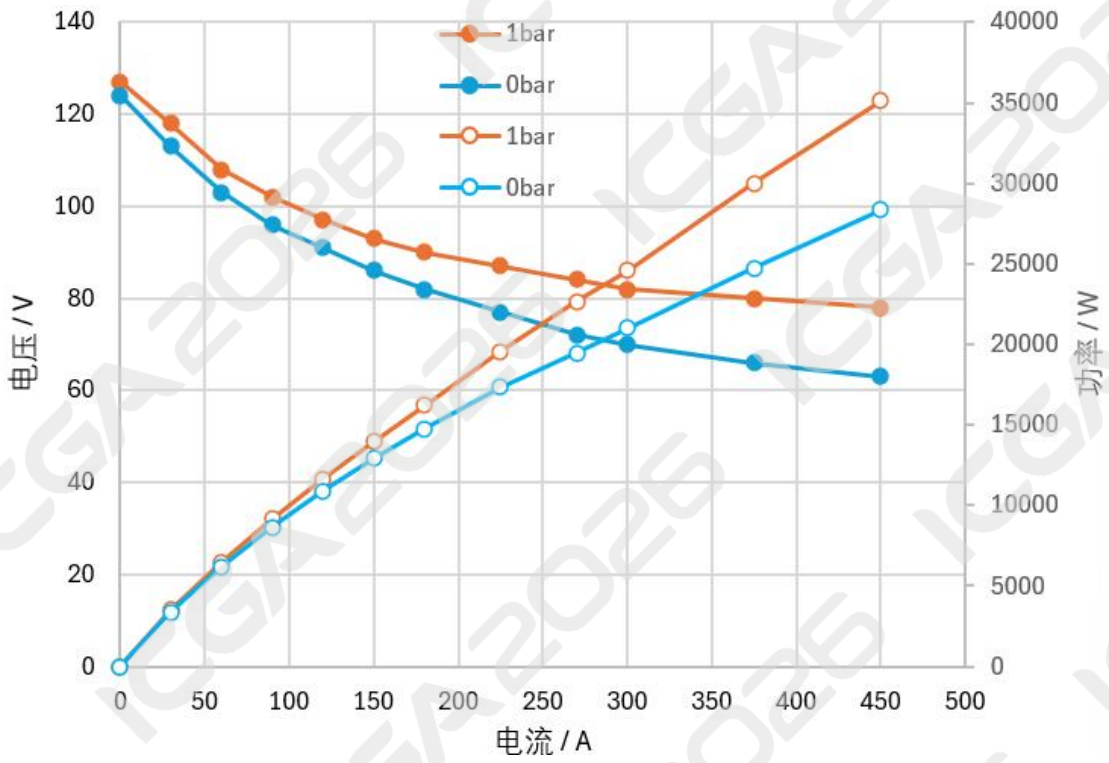


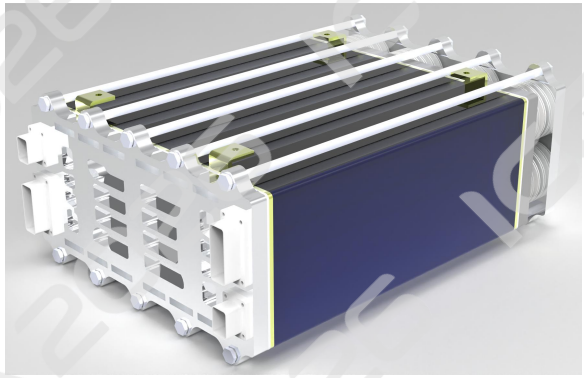
60kW Beijing First Set



New-Gen Aviation High Specific Power HT-PEMFC

北京航空航天大學 BEIHANG UNIVERSITY







Model	Hers-P30
Rated Power	36 kW
Weight	18 kg
Specific Power	2.0 kW/kg
MEA Type	PPtec®G3
Bipolar Plate	Metal
Operating Temp	150-180℃
Fuel	H_2 or MeOH Reformate
Electrical Efficiency	51%

Design new-gen high-temp PEM FC stack specific power 2.0 kW/kg

北京航空航天大學 BEIHANG UNIVERSITY

SENOHERS 海得利兹

COMAC 中国商用飞机有限责任公司 Commercial Aircraft Corporation of China, Ltd.

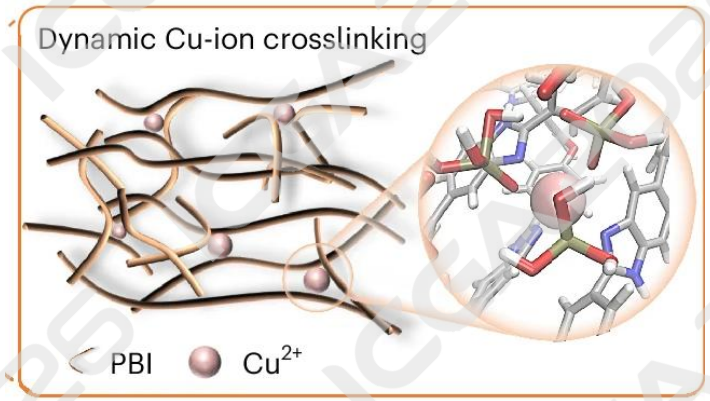
New-Gen Aviation High Specific Power HT-PEMFC

北京航空航天大學 BEIHANG UNIVERSITY

◻ Ultra-thin HT-PEM Tech

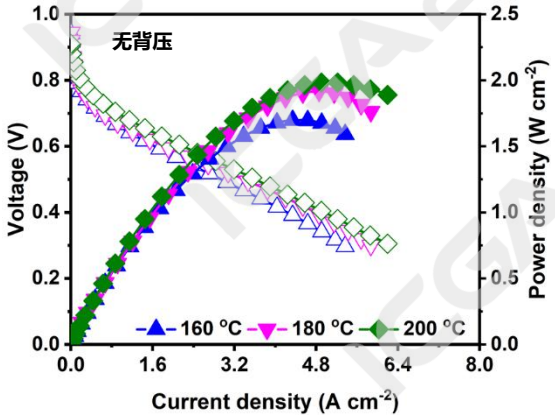
Cu-ion Crosslinking HT -PEM

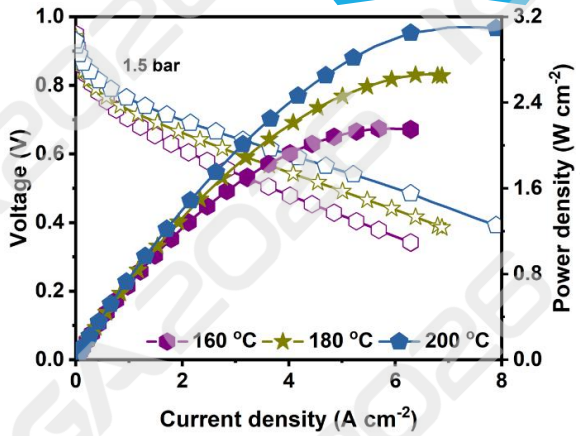
- ✓ Thin，low resistance
- ✓ Lower H_2 permeability
- ✓ Higher mechanical strength



New-Gen High Power HT-MEA G3

3.1W/cm²





Nature Energy, 2026, 11, 1043–1054.

Academician Expert Panel Evaluation

科 技 成 果 评 价 报 告

中汽学评[2024] 第 72 号

成果名称： 宽温域质子交换膜的创制与示范应用

委托评价单位： 北京航空航天大学

评价机构：中国汽车工程学会（盖章）

评价完成日期： 2024 年 12 月 04 日

该项目技术难度大、创新性强，拥有自主知识产权，项目成果显示度高，已实现了 4 MW/年规模化产能，经济和社会效益前景显著，总体技术达到国际领先水平。

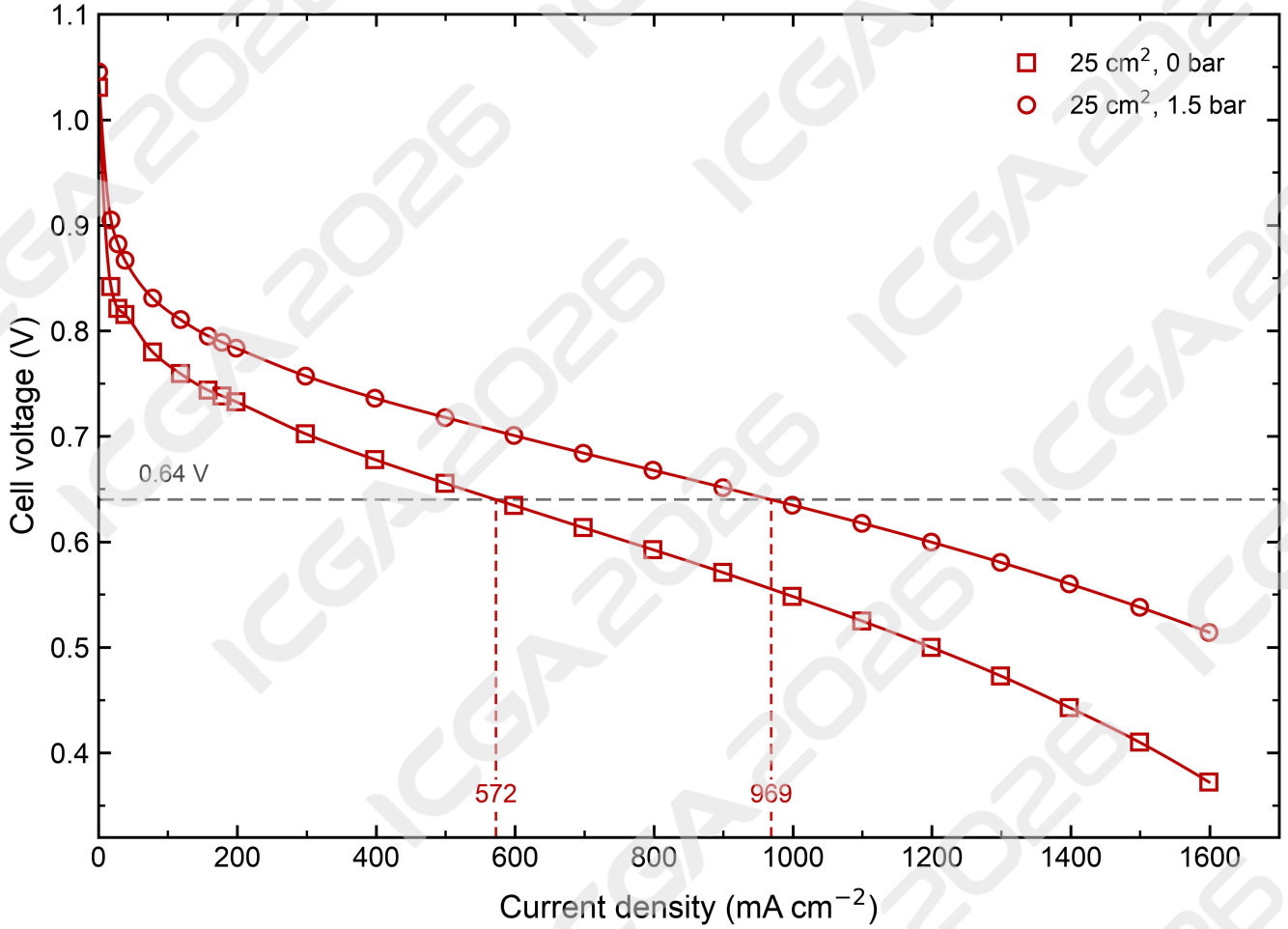
Overall tech reaches international leading level.

专家组组长（签字）：

2024年 12月 4日

HT-PEM FC MEA Scaling Tech

Project target MEA performance: >1.0Acm^{-2}@0.64V (H_2/air)



MEA Size	25cm²
Test Condition	H_2(1.25)/air(2.5)
Current Density @0.64V(0bar)	0.57 A/cm²
Current Density @0.64V(0bar)	0.97 A/cm²

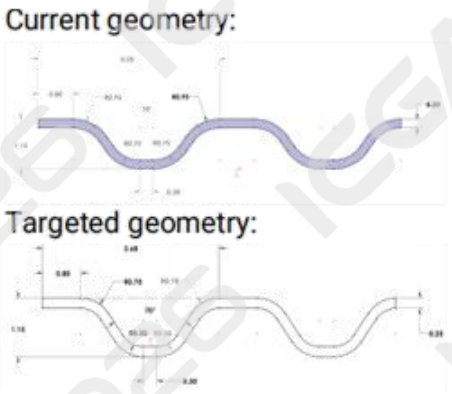
Verified small-size 25cm² MEA, confirmed MEA composition and fabrication process. Currently developing 350cm² standard-size MEA.

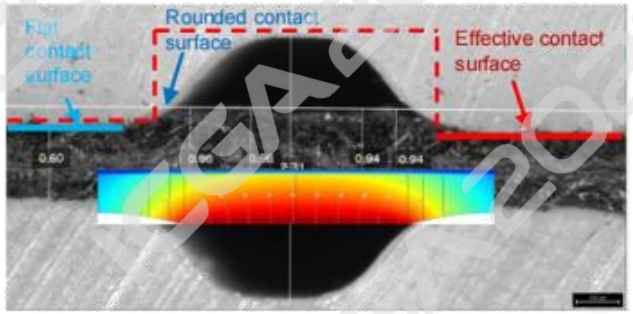
High-Temp Bipolar Plate Tech

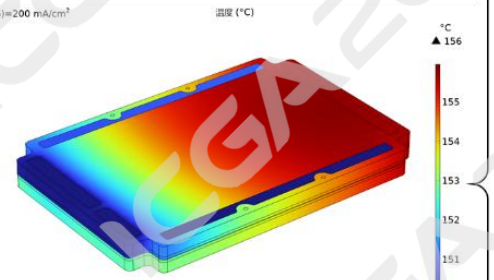
- Lightweight Metal Substrate SS316L
- Corrosion-Resistant Coating
- High Mass Transport Flow Channel Design

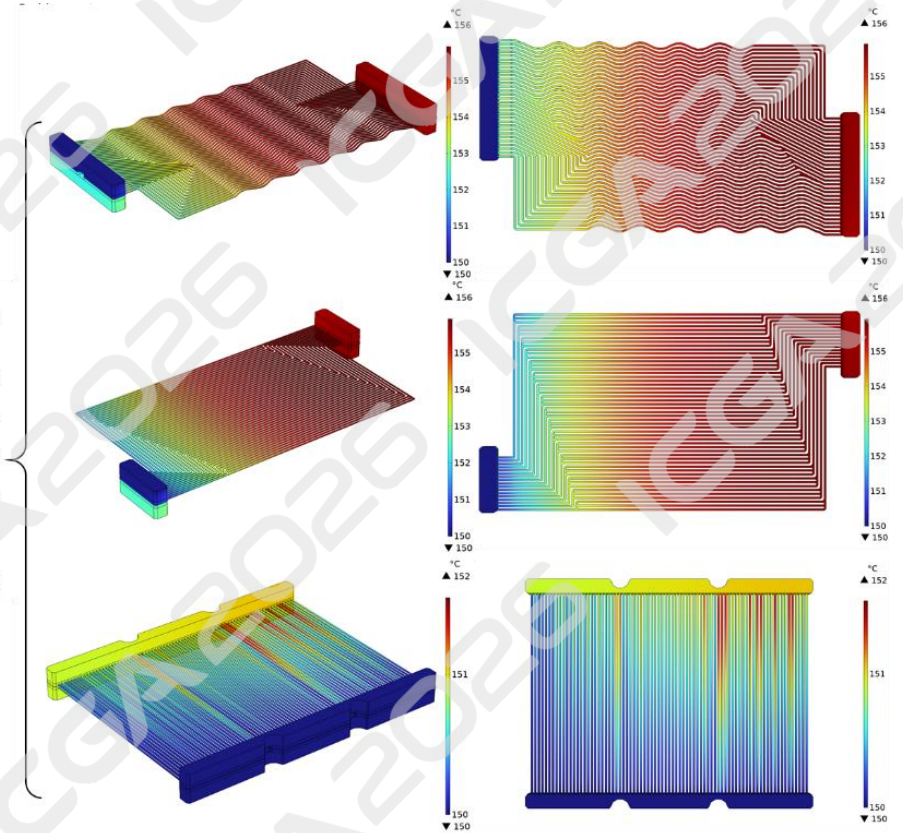
New-Gen Corrosion-Resistant Metal Bipolar Plate:







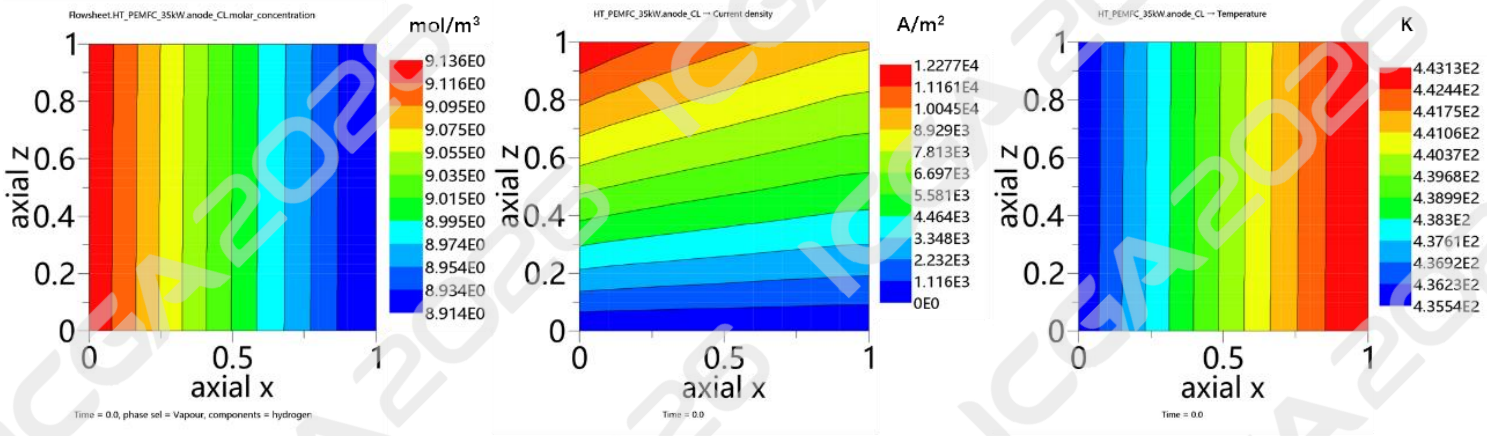




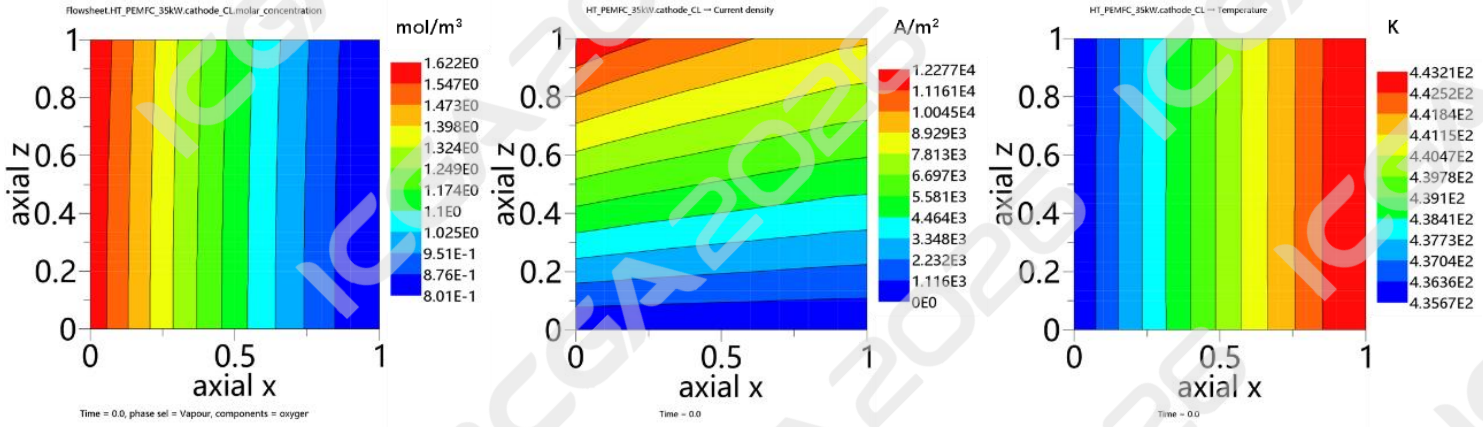
Overcoming 4 challenges in commercializing HT-PEMFC metal bipolar plates:

Corrosion - Coating - Lifespan - Cost

30kW HT-PEM FC System Simulation



- Anode & cathode flow channel isomorphism: Concentration↓, Current↓, Temperature↑
- Concentration dominates current density;
- Reaction heat raises temperature;



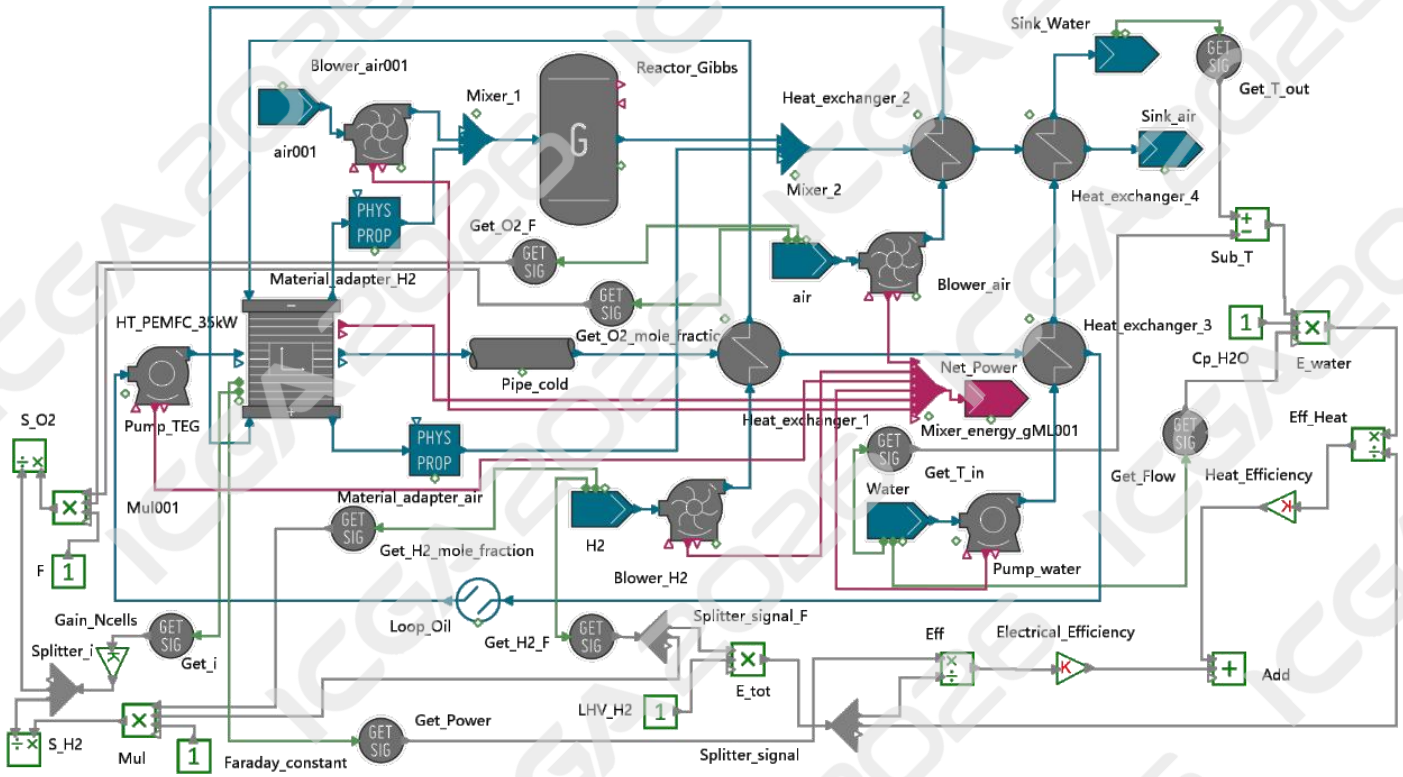
- Mass concentration decreases along the flow channel
- Current density decreases with concentration, more significant along z-axis
- Temperature rises along the flow channel due to reaction heat

H_2 decreases only 2.4% along the channel, O_2 decreases ~50%. Trends are isomorphic, but concentration change magnitudes differ by an order of magnitude.

New-Gen Aviation High Specific Power HT-PEMFC

北京航空航天大學 BEIHANG UNIVERSITY

- 30kW HT-PEM FC System Simulation
- Aspen Plus and gPROMS



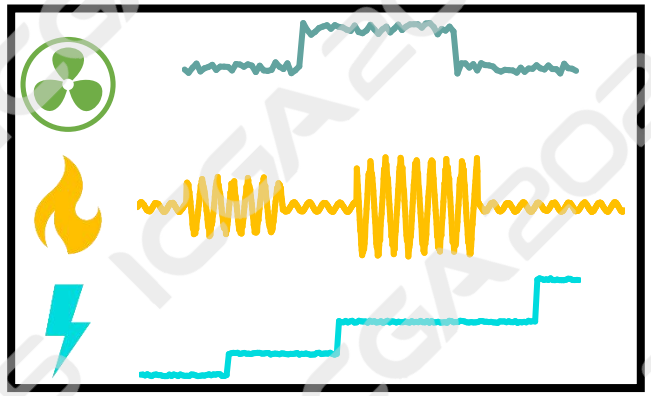
Parameter (Unit)	Value
Design Rated Output Power (kW)	35
H_2/Air Stoichiometry Ratio (-)	1.5 / 2.5
Stack Operating Current (A)	367
Single Cell Output Voltage (V)	0.64
Total Stack Output Voltage (V)	96.56
Rated Output Power (kW)	35.44
Rated Net Output Power (kW)	30.46
Coolant Stack Inlet Temp (℃)	160
Coolant Stack Outlet Temp (℃)	168.56
Electrical Efficiency(%)	51.36

System simulation shows net output power reaches 30.46kW, electrical efficiency reaches 51.36%

Data-Driven Digital Twin for BoP Reliability

北京航空航天大學 BEIHANG UNIVERSITY

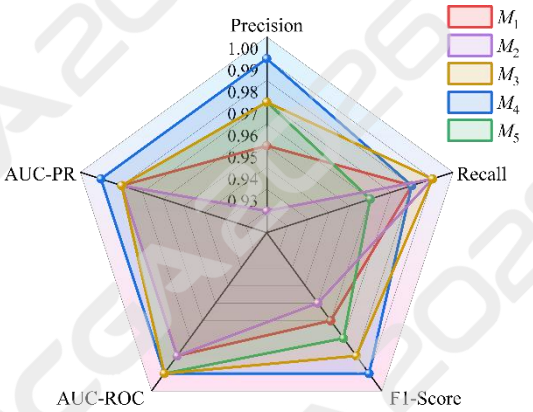




Fault Correlation

Feature Selection

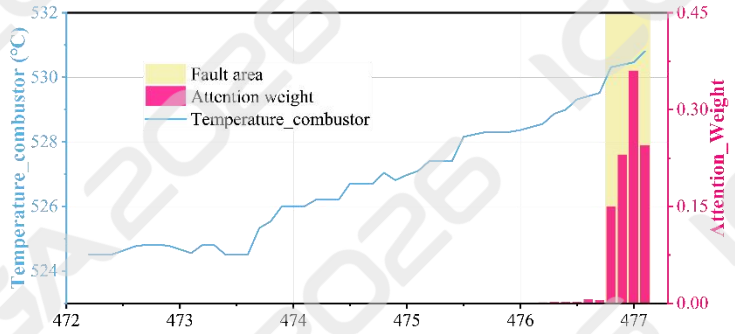
Class Imbalance

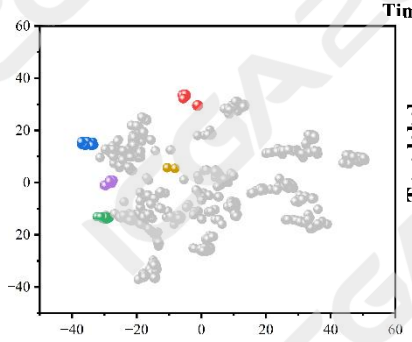


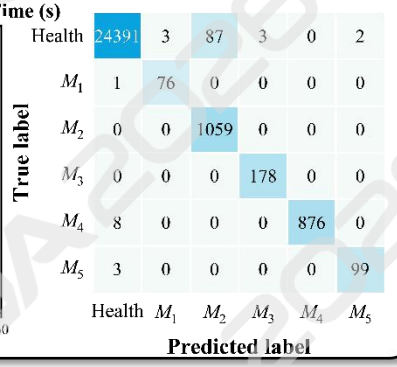
MSR-HT-PEMFC → Operational Data → AI-Driven Data Analysis → Model Training and Fault Diagnosis

Centralized training

- Temporal Convolution Network
- Attention Mechanism
- High Accuracy

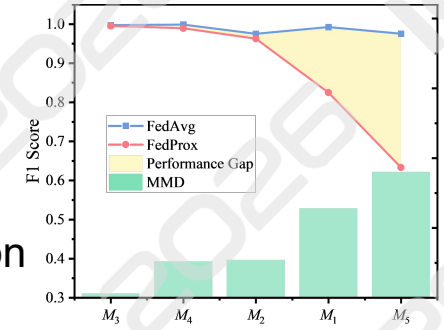


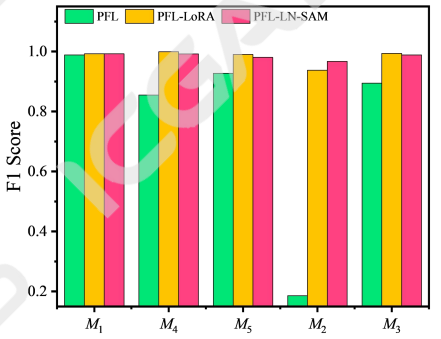


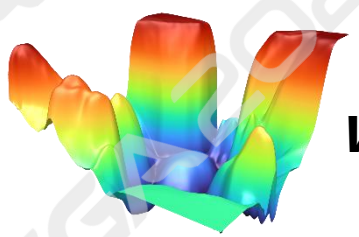


Federated Learning

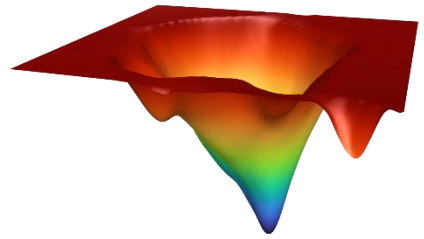
- Retain Normalization Layer
- Low-Rank Adaption
- Visualizing Loss Landscape







VS



Challenges in HT-PEMFC Industrialization

北京航空航天大學 BEIHANG UNIVERSITY

Scientific Challenges

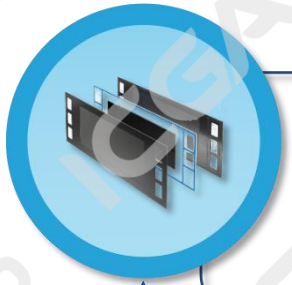
Performance

Reliability

Engineering Challenges



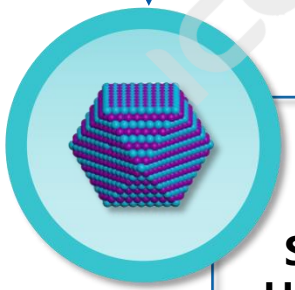
HT-PEM
Design & Mass Production of HT-PEM



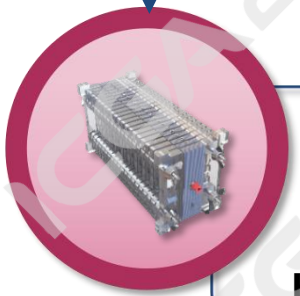
HT-MEA
Prep Tech & Dynamic Evolution of High-perf, Long-life HT-MEA



Integrated Control
Sys Energy Mgmt Principles & Safe Operation



Catalyst
Design, Prep & Service Behavior of High-activity Catalyst



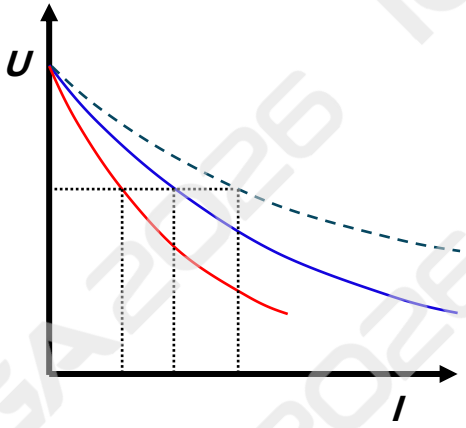
HT-Stack
Structure Design & Packaging Tech of High-eff HT PEM Stack

Material | Component | Device | Application

Key Challenges of Aviation FC Tech- FC

北京航空航天大學 BEIHANG UNIVERSITY

Fuel Cell Performance



LT PEM Fuel Cell
Ideal HT PEM Fuel Cell
Actual HT PEM Fuel Cell

Theoretical Advantages of High Temp

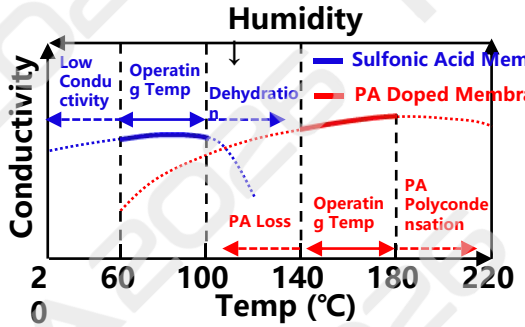
- ✓ Faster Kinetics
- ✓ Catalyst Anti-poisoning
- ✓ Simplified Hydrothermal Mgmt
- ✓ Faster Heat Dissipation

Bottleneck:
Insufficient Power Density!
Lack of In-situ Characterization!
New Energy Conversion Theories & Methods!

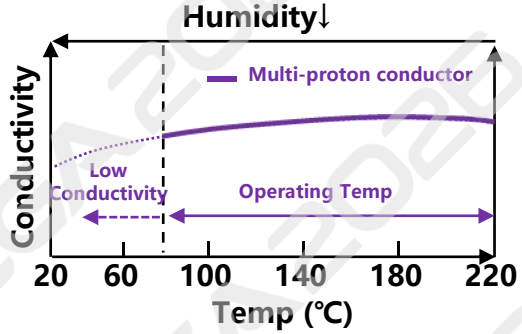
Scientific Challenges in Engineering

Solutions

PEM

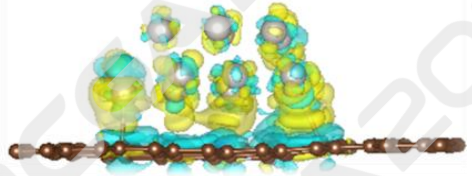


Maintain high conductivity in wide temp range

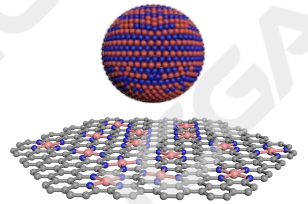


Wide-temperature-range PEM

Catalyst



Phosphoric Acid Poisoning + Carbon Corrosion



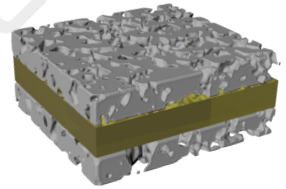
Ordered Alloy + Functionalized Support

MEA

Low O_2 Solubility & Diffusion Coefficient

(3.3×10^{-4} M, $1,21\times10^{-6}$ $cm^2\cdot s^{-1}$)

Slow Mass Transfer + Insufficient Stability



Precise Multiphase Interface Construction
Enhanced Transport/Reaction Kinetics

Basic Research Needs (Lab→Product)

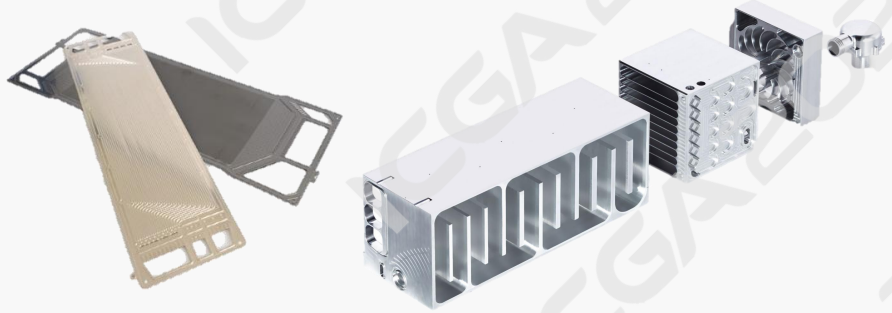
北京航空航天大學 BEIHANG UNIVERSITY

Industry Supply Chain

- Mass synthesis of high-efficiency catalysts
- Mass production of domestic high-performance carbon paper

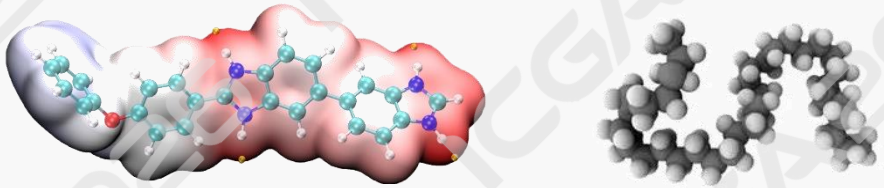


- Design & evaluation of corrosion-resistant high-temp bipolar plates
- Mass production design of high-pressure micro reformer reactors

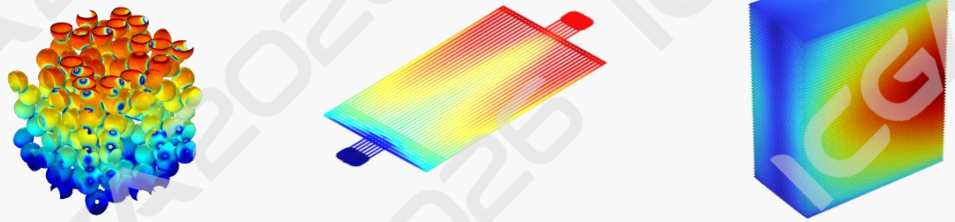


New Technology Iteration

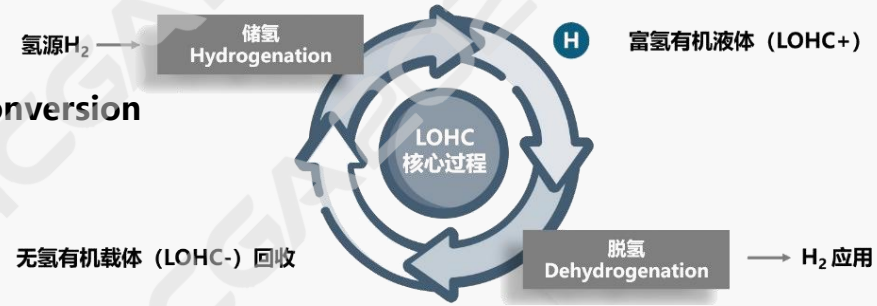
- Design & synthesis of high-temp polyelectrolytes



- AI-assisted catalyst & encapsulation system design and development



- Other hydrogen source adaptation & efficient thermal management technologies



✓ NH_3-H_2 conversion
✓ LOHC

SENOHERS
海得利兹

科技部

中国航空学会
Chinese Society of Aeronautics and Astronautics

NSFC

IAGA International Association for Green Aviation

Thanks!



ICGA2026