



铭寰能源



固体氧化物燃料电池发电 (SOFC) 和电解 (SOEC) 测试/烧结平台

Solid Oxide Fuel Cells (SOFC) and Solid Oxide Electrolysis Cells (SOEC) Test /Sintering Platform

精湛的工艺，源于对细节的掌控；高品质的电池，始于更专业的设备。让我们携手共同锻造固体氧化物燃料电池更高效、更持久的未来。
Precision in process comes from mastery of details; high-quality cells start with more professional equipment. Let's work together to forge a more efficient and durable future for solid oxide fuel cells.

核心功能 CORE FUNCTION



卓越性能评估

Outstanding Performance Evaluation

精准模拟多种压力与温度环境
Precisely simulates various pressure and temperature environments

提供 IV 曲线、功率密度、效率等核心参数
Provides key parameters such as IV curves, power density, and efficiency

为科研与产业化提供可靠数据支撑
Offers reliable data support for scientific research and industrialization



材料创新研发

Materials Innovation and R&D

精确温度与气氛控制, 确保实验可重复性
Accurate temperature and atmosphere control ensures experimental repeatability

深入解析材料微观结构与性能
In-depth analysis of material microstructure and properties

为新型电解质、电极、密封与连接体确定最佳烧结工艺
Determines optimal sintering processes for new electrolytes, electrodes, seals, and connectors



高端人才培养平台

High-End Talent Training Platform

一体化、直观的操作界面
Integrated, intuitive operation interface

安全展示 SOFC/SOEC 核心工艺与测试原理
Safely demonstrates SOFC/SOEC core processes and testing principles

打造、科研、教学、产业三位一体的人才培养生态
Builds a talent training ecosystem integrating research, teaching, and industry

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长期耐久与衰减验证

Long-Term Durability and Degradation Verification

支持数百至数千小时的稳定运行
Supports stable operation from hundreds to thousands of hours

全面评估 化学稳定性、热循环耐受性、结构蠕变、密封件老化
Comprehensive evaluation of chemical stability, thermal cycling resistance, structural creep, and seal aging

为产品寿命与安全性提供权威保障
Provides authoritative assurance for product lifespan and safety



智能制造与质量提升

Intelligent Manufacturing and Quality Improvement

标准化工艺与高精度控制体系
Standardized processes and high-precision control systems

显著提升生产效率与一致性
Significantly improves production efficiency and consistency

助力企业实现规模化、智能化生产
Helps enterprises achieve large-scale, intelligent production



多路气体集成与智能预热

MULTI-GAS INTEGRATION AND INTELLIGENT PRE-HEATING

模块化设计:

Modular design:

支持 5 路独立高纯气路 (H₂、保护气、空气、N₂、水蒸气), 并可扩展至合成气、加湿空气等。

Supports five independent high-purity gas lines (H₂, protective gas, air, N₂, steam), expandable to syngas, humidified air, etc.

高精度控制:

High-precision control:

每路配备质量流量控制器 (MFC), 精度 ±1%F.S., 实现程序化梯度控制, 覆盖启动、运行、负载切换、停机全工况。

Each line equipped with a mass flow controller (MFC), accuracy ±1% F.S., enabling programmable gradient control for all operating conditions (start-up, operation, load switching, shutdown).

智能预热:

Intelligent pre-heating:

气体进入电堆前动态预热, 避免“冷气冲击”, 防止电池片开裂、密封失效, 提升测试一致性。

Dynamic pre-heating of gases before entering the stack to avoid "cold gas shock," prevent cell cracking and seal failure, and improve test consistency.





高性能气动升降炉

HIGH PERFORMANCE PNEUMATIC LIFTING FURNACE

精密控温：

Precise temperature control:

分区加热 + PID闭环控制，测试区温度均匀性优于 $\pm 5^{\circ}\text{C}$ (@ 950°C)，最高温度可达 950°C 。

Zoned heating + PID closed-loop control, test zone temperature uniformity better than ± 5 (@ 950°C), maximum temperature up to 950°C .

智能升降：

Intelligent lifting:

气压伺服系统 + 直线导轨，平稳、静音、可编程升降，与温度/气体流程智能联动。

Pneumatic servo system + linear guide, smooth, silent, programmable lifting, intelligently linked with temperature/gas flow.

节能高效：

Energy efficient:

特种复合纤维保温，能耗较传统炉体降低约 25%。

Special composite fiber insulation reduces energy consumption by about 25% compared to traditional furnaces.



主动安全防护

ACTIVE SAFETY PROTECTION

硬件双重限位：

Dual hardware limits:

温度、压力超限保护优先于软件逻辑。

Temperature and pressure over-limit protection prioritized over software logic.

逻辑连锁：

Logic interlock:

气体泄漏传感器、停电/停气自动切换至安全气路。

Gas leak sensors, automatic switch to safe gas route during power/gas outage.

全方位保护：

Comprehensive protection:

红外屏障、机械互锁、过流过压过载防护。

Infrared barriers, mechanical interlocks, overcurrent/overvoltage/overload protection.

智能报警：

Intelligent alarms:

异常触发分级警报（屏幕、声光、短信），自动执行紧急预案。

Multi-level alarms (screen, audio-visual, SMS) triggered by anomalies, automatic emergency plans executed.

应急停机：

Emergency shutdown:

独立 E-STOP，一键切断所有动力与能源。

Independent E-STOP, one-button cut-off of all power and energy.



全自动电堆压紧力控制

FULLY AUTOMATIC STACK COMPRESSION CONTROL

多维力感知：

Multi-dimensional force sensing:

高灵敏度压力传感器实时监测轴向压力，精度达 $\pm 0.2\%$ 。

High-sensitivity pressure sensors monitor axial pressure in real time, accuracy up to $\pm 0.2\%$.

闭环控制：

Closed-loop control:

电动伺服/高精度气动执行，实现动态加载、保持与卸载。

Electric servo/high-precision pneumatic actuation for dynamic loading, holding, and unloading.



仿生加载:

Bionic loading:

自平衡设计, 均匀分布压力, 可模拟恒定压紧或随温度变化的补偿曲线。

Self-balancing design for even pressure distribution, simulating constant compression or temperature-compensated curves.

核心价值:

Core value:

为电堆结构设计与装配工艺优化提供权威数据支撑。

Provides authoritative data support for stack structure design and assembly process optimization.



集中式智能人机界面与数据中枢

CENTRALIZED INTELLIGENT HUMAN-MACHINE INTERFACE AND DATA HUB

一站式流程管理:

One-stop process management:

炉体升降、温度、气体配比、压力加载、安全监控全流程集成。

Integrated control of furnace lifting, temperature, gas mixing, pressure loading, and safety monitoring.

全景可视化:

Panoramic visualization:

实时工艺流程图, 关键数据曲线动态显示, 历史数据随时回溯。

Real-time process flow diagrams, dynamic display of key data curves, historical data review at anytime.

强大数据管理:

Powerful data management:

高频率自动存储, 支持导出与报告模板定制, 一键生成标准化测试报告。

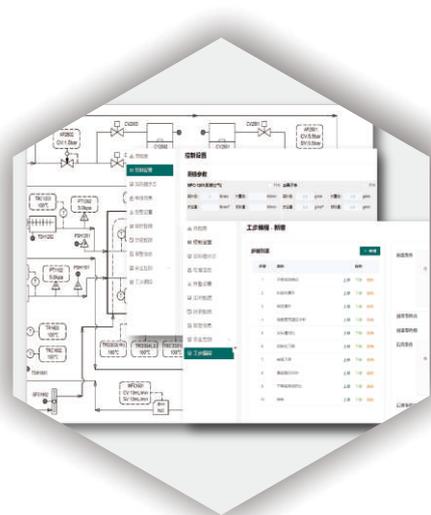
High-frequency automatic storage, supports export and custom report templates, one-click generation of standardized test reports.

远程互联:

Remote connectivity:

支持以太网/Wi-Fi, 工程师可远程诊断, 用户可安全查看实验进程。

Supports Ethernet/Wi-Fi, engineers can diagnose remotely, users can safely monitor experiment progress.



我们的承诺与价值交付

OUR COMMITMENT AND VALUE DELIVERY

交钥匙工程

Turnkey Project

从场地规划、安装调试, 到全面培训与售后支持, 提供一站式全流程服务, 确保客户快速、安全地投入使用。

From site planning, installation, and commissioning to comprehensive training and after-sales support, providing one-stop full-process service to ensure customers can quickly and safely start using the platform.

定制化灵活性

Customizable Flexibility

平台核心模块(炉膛尺寸、气路类型、压力范围等)可根据客户的研究需求灵活配置与扩展, 打造专属解决方案。

Core modules (furnace size, gas types, pressure range, etc.) can be flexibly configured and expanded according to research needs, creating tailored solutions.

持续技术支持

Continuous Technical Support

由资深科学家与工程师团队提供专业支持, 协助制定实验方案, 并与客户共同探索前沿课题, 推动创新突破。

Professional support from experienced scientists and engineers, assisting in experimental planning and exploring cutting-edge topics with customers to drive innovation.

卓越投资回报 Excellent Return on Investment

通过加速研发进程、提升测试成功率、延长设备稳定运行时间，平台成为客户最高生产率、最可靠数据的核心资产。
By accelerating R&D, improving test success rates, and extending stable operation time, the platform becomes the core asset for customers' highest productivity and most reliable data.

EnableR-I 关键技术参数表

ENABLER-I KEY TECHNICAL PARAMETERS TABLE

电流范围 Current range	0-100A	去离子水汽化 Deionized water vaporization	≤350 °C
电压范围 Voltage range	0-600 VDC	高温炉温度 High-temperature furnace temperature	≤950 °C
空气流量范围 Air flow range	0-300 NL/min	高温炉膛尺寸 High-temperature furnace chamber size	450×450×600mm
H ₂ /N ₂ 流量范围 H ₂ /N ₂ flow range	0-50 NL/min	电堆加压 Stack compression	70-7000 N/行程450mm
蒸汽流量范围 Steam flow range	0-30 ml/min	温度测量 Temperature measurement	25 路 (电堆8路)
保护气流量范围 Protective gas flow range	0-50 NL/min	电压测量 Voltage measurement	16 通道/16位 (分辨率)
空气预热 Air preheating	≤750 °C	电子负载 Electronic load	1500W/100A/600V
原料气预热 Feed gas preheating	≤750 °C	备用电源 Backup power	800W/1kVA/220VAC
产品尺寸 Product dimensions	1450×1200×2450mm	产品重量 Product weight	~900kg

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