

# FCV Activities in China

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CATARC

# Contents

- 1. Test Facilities and capability**
- 2. Codes and Standards Development**
- 3. Research Projects**

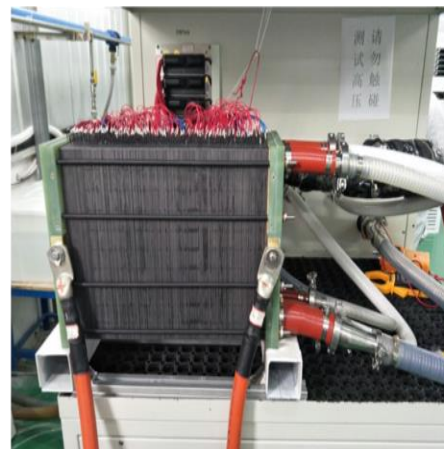
# 1.1 FC stack / FCE



燃料电池发动机测试台



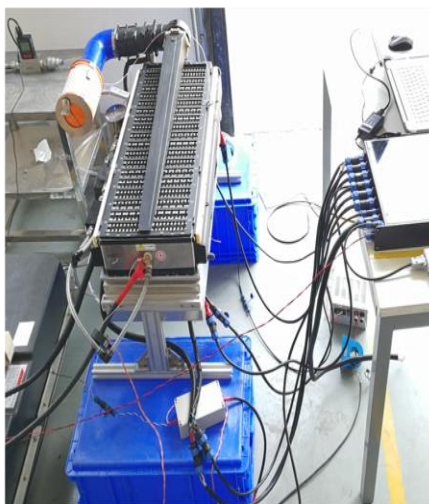
燃料电池发动机测试台



燃料电池堆性能试验



燃料电池发动机冷起动试验



燃料电池风冷型发动机



甲醇重整燃料电池发动机



基于进口电堆燃料  
电池发动机



基于国产电堆燃料  
电池发动机

# 1.2 refueling etc



加氢口气密性试验



加氢口循环脉冲耐久性试验



车载氢系统模拟碰撞试验



车载氢系统气瓶位移试验



整车最高车速试验



整车续驶里程试验



整车安全要求试验



车载氢系统技术条件

# 1.3 public service for FCVs

## 硬件平台建设

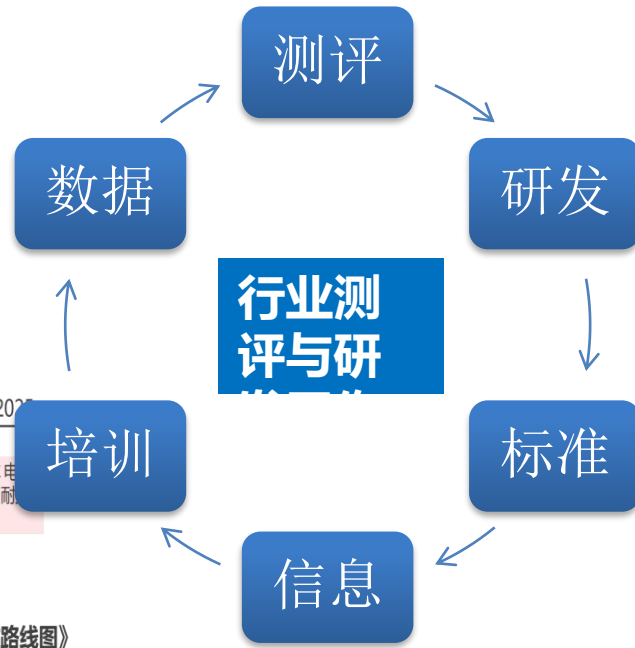
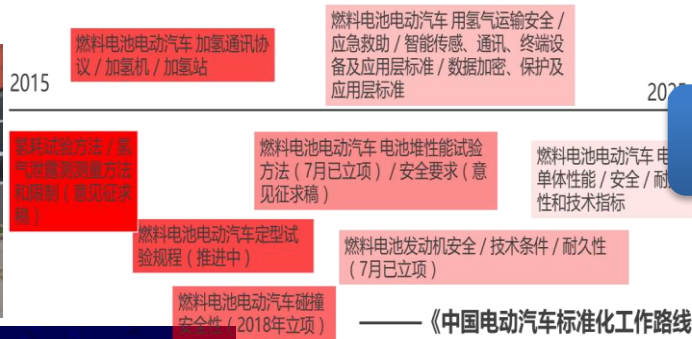
- 电堆测试平台（由20kW至100kW）
- 系统测试平台（新增温湿度环境仓建设）
- 高压附件测试平台（由35MPa至70MPa）
- 整车道路测试平台（由安全测试至全方位性能测试）

## 软件平台建设

- 燃料电池发动机耐久性加速工况、电堆性能试验方法、振动环境可靠性测试等多项**标准及CATARC规范**研究制定；
- 新能源汽车重点专项等**科研课题研究**工作；
- 开展行业技术现状调研、技术咨询、行业会议；

## 重点项目开展

- 开展**20余款整车、30余款系统测试**
- 联系拓展服务业务范围（中车、船舶等）
- **成立院士工作站**，提高行业影响力；
- **借力国家创新联盟**，建立技术交流访问机制；
- **牵头组织成立行业测评与研发工作组。**



# 1.4 FCV safety



氢瓶安装强度位移试验



氢系统管路安装牢固、压力释放口



储氢容器仓、动力系统仓氢气传感器



燃料电池冷启动



车载氢模拟碰撞试验



燃料电池发动机气密性、绝缘电阻



车载氢系统振动试验



加氢口-耐压力、耐久性、耐老化、气密性等



仪表盘能监控电堆和氢系统状况



尾气探测

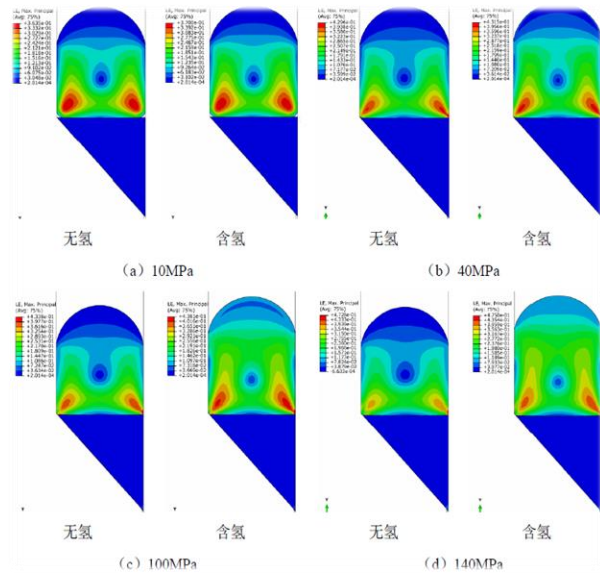


燃料电池发动机电磁兼容试验

# 1.5 Material Test with Ultra-high Pressure Hydrogen

1<sup>st</sup> Generation of HyMTS

2<sup>nd</sup> Generation of HyMTS



HP hydrogen combination seal simulation model



Key components

- ✓ Max pressure: **140MPa**
- ✓ Force: **120kN (static)**  
**100kN (dynamic)**
- ✓ Tests: Fatigue Test  
Slow Strain Rate tensile  
Fatigue crack growth  
rate test

Unit	P / MPa	T / °C	On-off way
ZJU	140	-60~100	Quick opening structure of teeth-mashing

# 1.6 Material Tests for Hydrogen Embrittlement

1. Thermal Desorption Spectroscopy (TDS)



- ✓ Max ramp rate: **40K/min**
- ✓ Temp. range: **RT- 1500°C**
- ✓ Min pressure  $10^{-7}$ Pa



2. In-situ TEM



- ✓ Test medium: **H<sub>2</sub>**
- ✓ Pressure  $10^{-4} \sim 10^{-1}$  Pa



3. AFM/KPFM /MFM



*Under way in ZJU...*



4. Nanoindentation



5. HPTHC

- ✓ Max pressure: **132 MPa**
- ✓ Max Temp.: **300°C**

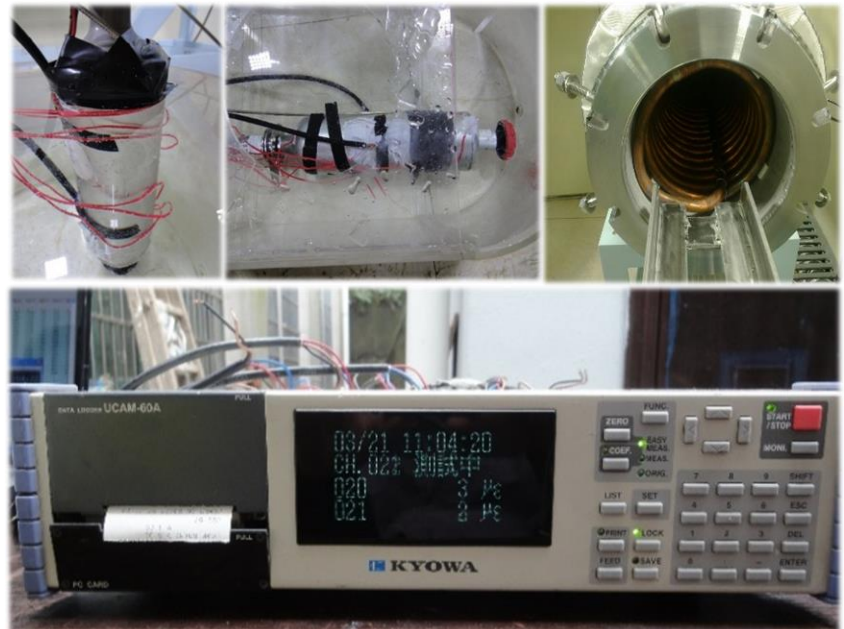


# 1.7 Component test system with HP H<sub>2</sub> (HyCTS)

## Hydrogen Cycling System



- ✓ Test medium: **H<sub>2</sub>**
- ✓ Max pressure: **90MPa**
- ✓ Test temp.: **-40°C~90°C**
- ✓ Application:  
Components in contact with HP. Eg: check valve, shut-off valve, PRD etc.



# 2. Codes and Standards Development

## ■ National Standardization Technical Committee

- ✓ National Standardization Technical Committee of Hydrogen Energy (**SAC/TC 309**)
- ✓ National Standardization Technical Committee of Gas Cylinders (**SAC/TC 31**)  
(Subcommittee on High pressure vehicle fuel tank, **SAC/TC 31/SC8**)
- ✓ National Standardization Technical Committee of Automotive Vehicle (**SAC/TC 114**)
- ✓ National Standardization Technical Committee of Boiler & Pressure Vessels (**SAC/TC 262**)

# 2. Codes and Standards Development

## ■ National Standard

✓ *FCVs*

No	Std No	Title
1	GB/T 24549-2009	FCV safety requirements
2	GB/T 24554-2009	FCE Performance test methods
3	GB/T 26779-2011	FCV refueling nazzle
4	GB/T 26990-2011	FCV onboard H2 sys specification
5	GB/T 29126-2012	FCV onboard H2 sys test method
6	GB/T 24548-2009	FCV terminology
7	GB/T 26991-2011	FCV max speed test method
8	GB/T 29123-2012	FCV for demo-running
9	GB/T 29124-2012	Infrastrucutre for FCV
10	QC/T 816-2009	H2 refueling Vehicle
11	<i>GB/T 25319-2010</i>	<i>FCV FC-power sys specification</i>
12	<i>GB/T 23645-2009</i>	<i>FCV FC-power sys test method</i>
Note: mandatory use		

# 2. Codes and Standards Development

## ■ National Standard

✓ *FCVs*

No	Std No	Title
1	GB/T	FCV H2 consumption
2	GB/T	FCV H2 emission
3	GB/T	FCV stacks test method
4	GB/T	FCV refueling protocol
5	GB/T	FCV type approval procedure
6	GB/T	FCV energy consumption and range
7	GB/T	FCE durability accelerated test

# 2. Codes and Standards Development

## ■ National Standard

### ✓ *Stationary hydrogen storage and hydrogen refuelling station*

- TSG 21-2016 Supervision Regulation on Safety Technology for Stationary Pressure Vessel
- GB/T 26466 Stationary flat steel ribbon wound vessels for storage of high pressure hydrogen
- GB50516 Technical code for hydrogen fueling station
- GB/T30718 Compressed hydrogen refuelling connection devices for surface vehicle
- GB/T 34019 Ultra-high Pressure Vessels
- GB/T XXX Storage and transportation systems for gaseous hydrogen Part 1: General requirements

# 2. Codes and Standards Development

## ■ National Standard

### ✓ *On-board hydrogen storage system*

- TSG R0006-2014 Supervision Regulation on Safety Technology for Gas Cylinders
- GB/T 29126 Fuel cell electric vehicles - On-board hydrogen system-Test methods
- **GB/T XXX Fully-wrapped carbon fiber reinforced cylinders with an aluminum liner for on-board storage of compressed hydrogen gas as a fuel for land vehicles**

# 2. Codes and Standards Development

## ■ National Standard

### ✓ *Hydrogen safety and hydrogen compatibility*

- GB/T 29729 Essential safety requirements for hydrogen systems
- GB/T31139 Safety technical regulation for mobile hydrogen refuelling facility
- **GB/T XXX Safety technical requirements for hydrogen storage devices used in hydrogen station**
- **GB/T XXX Test methods for evaluating metallic material compatibility in compressed hydrogen**
- **GB/T XXX Test method of hydrogen embrittlement for metallic materials**

# 3. Research Projects

- ✓ IPHE: Type IV COPV Round Robin Testing, Round Robin for Materials qualification for Hydrogen Service
- ✓ International Conference: ICHS, ICH2P2016, ASME PVPC CS-34
- ✓ HySafe: State-of-the-Art and Research Priorities in the Hydrogen Safety
- ✓ International Regulations and Standards



# 3. Research Projects

## **Research on Design and Fabrication of Components in Contact**

**With High Pressure Gaseous Hydrogen (2015CB057600)**

### **Tasks:**

- (1) Evaluation of Hydrogen Compatibility for Industrial Materials**
- (2) Degradation Mechanisms of Materials in Contact With High Pressure Gaseous Hydrogen**
- (3) Effects of Fabrication Technology on Component Hydrogen Suitability**
- (4) Hydrogen-damage Mechanism Based Methods for Design of Components**
- (5) Provide Data for Standards and Technology Applied to Components for Hydrogen Service ( Standards for Materials, Components, Systems)**

# THANKS !

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