

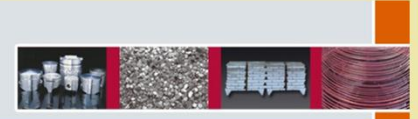


12º SEMINÁRIO DE  
**METAIS NÃO FERROSOS** 2011



# Fuel Cell Technology

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## WHY FUEL CELLS?

When you consider that every gallon of gasoline burned in an automobile produces 20 pounds of carbon dioxide, it is easy to see why the transportation sector is responsible for one quarter of all carbon dioxide emissions.

According to the National Refuse Council, the average car produces 10,700 pounds of air pollution per year. 150 million cars in the United States...vehicle miles travelled doubling every 25 years...leads us to a lot of work being done in search of an alternative to today's internal combustion engine.



## Materials applied in vehicles powered by Fuel cells

**Electric Engine  
Fuel Cell Package**

**Body**

**Suspension**

**Electric components**

**Appearance**

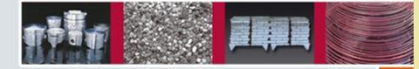
**Wheels**

**Tank**

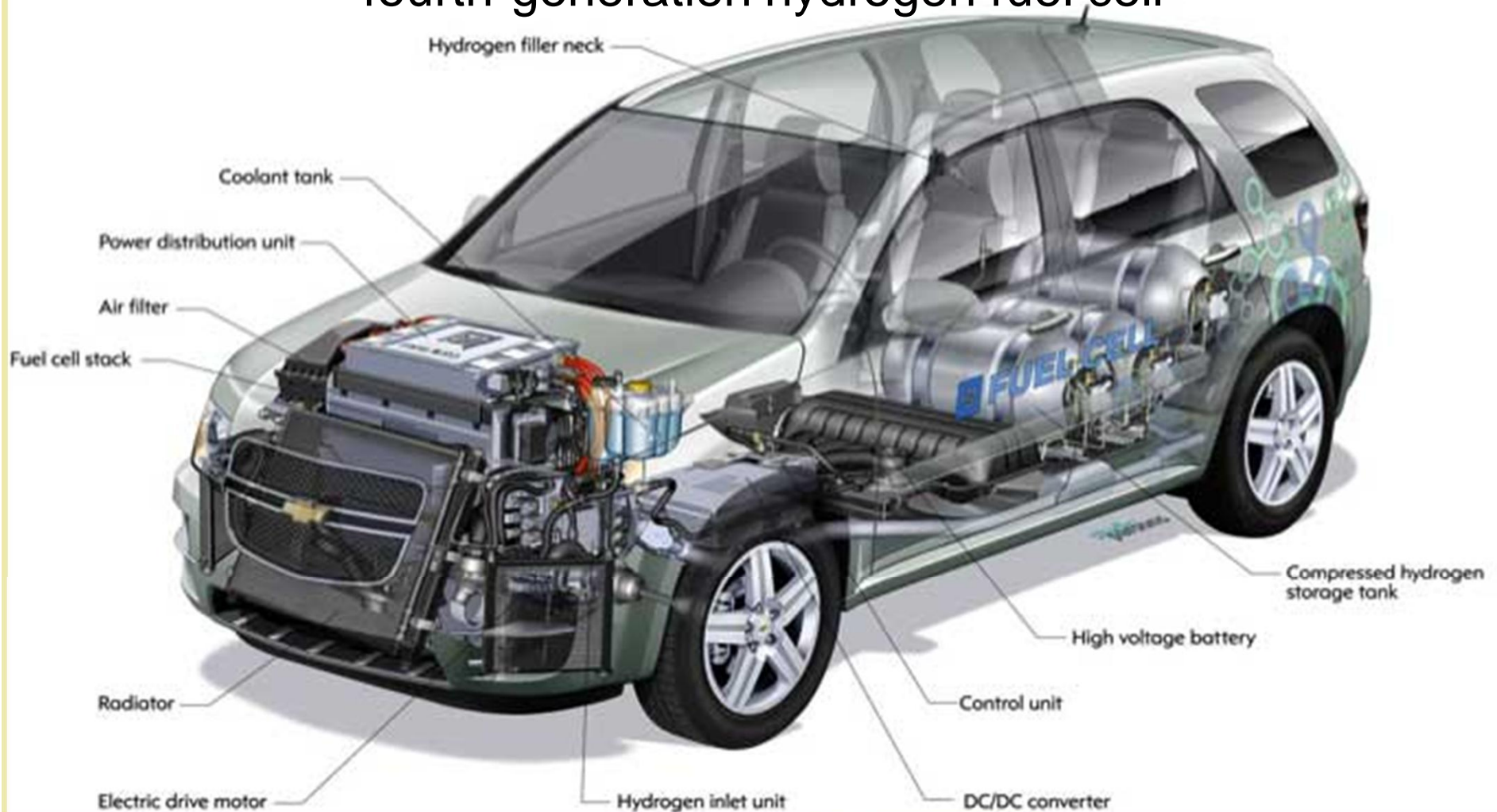
**Battery**

**20-40%  
Non-ferrous  
(by 2015)**

**60-80%  
Non-ferrous  
(by 2030)**

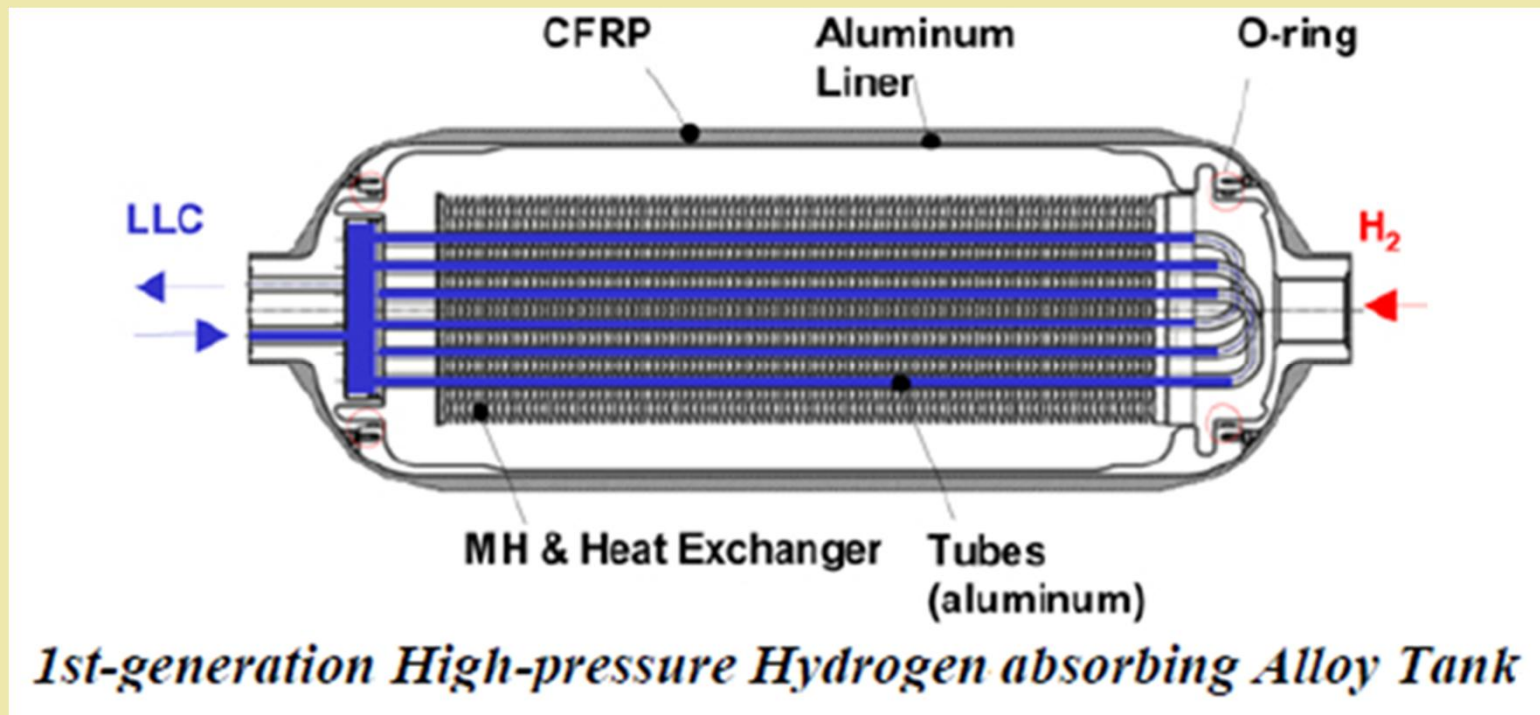


Under the hood of this Chevrolet Equinox is an advanced, fourth-generation hydrogen fuel cell





- It contains hydrogen absorbing alloy and a heat exchanger within a split aluminum liner based on a 35 MPa Type III tank.
- The heat exchanger is a fin and tube type, and heating medium pipes capable of withstanding pressure up to 35 MPa are provided inside the tank.
- This tank features 10 to 40 aluminum cylinders that are bundled together and filled with hydrogen-absorbing alloy





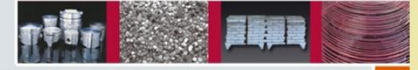
# Estimation of Tank Performance.



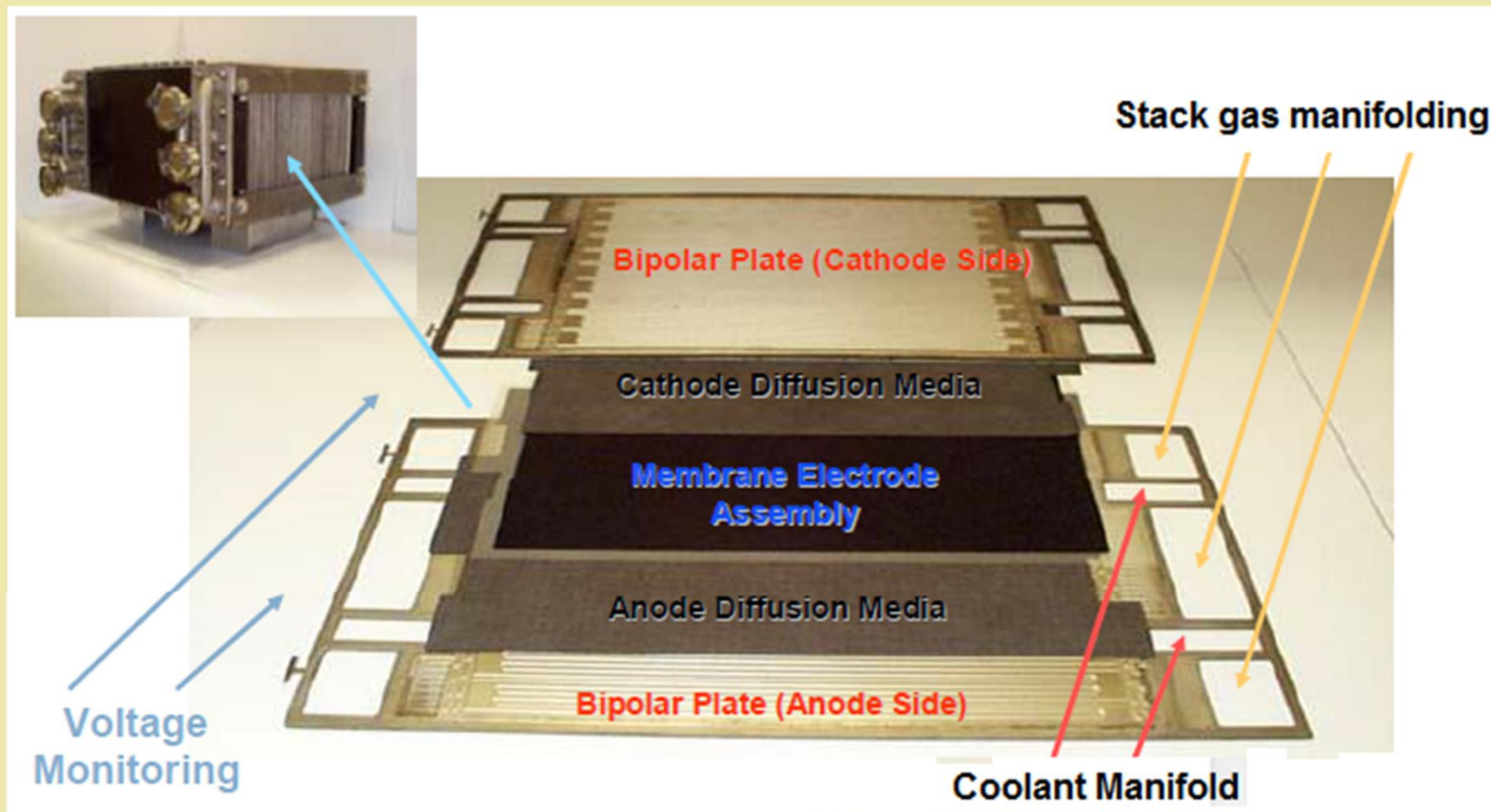
*2nd-generation High-pressure Hydrogen absorbing Alloy Tank.*

	1 <sup>st</sup> -generation High-pressure Hydrogen-absorbing Alloy Tank. Ti-Cr-V-Mo(BCC) 35MPa System	2 <sup>nd</sup> -generation High-pressure Hydrogen-absorbing Alloy Tank. MH based on Ti-Cr-Mn	
Tank Volume	Tank 95L	Tank 83L	
Tank Weight	225 kg	207 kg	
Hydrogen Storage Density in Weight	2.5mass%	2.5mass%	3.0mass%
H <sub>2</sub> Capacity	H <sub>2</sub> 5kg	H <sub>2</sub> 4.2kg	H <sub>2</sub> 5.0kg
H <sub>2</sub> Filling Time	5 min. / 72% of Max. Capacity(13 L Tank) Over 80% is possible by decreasing hysteresis of equilibrium pressure between absorbing and desorbing	5 min. / 60% of Max. (Thermal conductivity of 1W/m·K ) 5 min. / 80% of Max. (Improved thermal conductivity of 10 W/m·K and over charge)	
Control-Ability	Good Equal to high-pressure tank	Good Equal to high-pressure tank	

Ref. Komiya Kenji, Mori Daigoro and Miura Shinpei Toyota Motor Corporation, SAE 2010-01-0851, Published, 04/12/2010

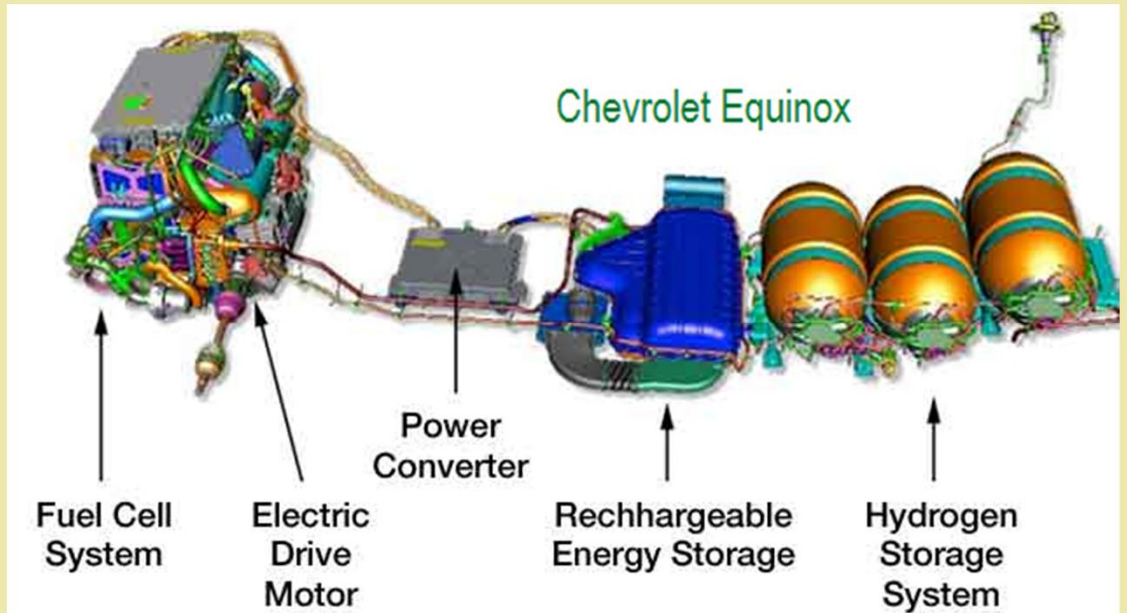


## FUEL CELL STACK REPEATING UNIT COMPONENTS





# MAJOR COMPONENTS OF A FUEL CELL SYSTEM



**FCPS Integration** (Breakdown of requirements into subsystems; optimization and validation)  
 FCPS integration components; controls/software, safety functions (high voltage, hydrogen)

**Hydrogen Storage System (HSS)**  
 ( $H_2$  receptacle  $\rightarrow$  on board, on board  $\rightarrow H_2$  to FCS)

Compressed

**Fuel Cell System (FCS)**  
 ( $H_2$  in  $\rightarrow$  DC electrical power out)  
 Fuel Cell System

**Fuel Cell Stack**  
 (PEMFC for vehicle main power source)

**Fuel Cell System Subsystems**

- Compressor
- Humidification
- FCS Controls

**Rechargeable Energy Storage System (RESS)**

- Secondary battery
- Capacitor
- Others

**Electric Traction System (ETS)**  
 (DC in  $\rightarrow$  Torque out)

- Motor
- Gearbox
- Inverter
- etc.



## **Planning for fuel cell applications:**

**Product Engineering**

**R&D Department**

**Manufacture**

**Suppliers**

**Raw material**

**Cost / Volume**

**Environment**

**Emission**

**Fuel Consumption**