

Setting up of Fuel Cell lab

Fuel cell laboratory consists of the following equipment

1. Dr. Fuel cell model car
2. Solar hydrogen technology science kit
3. Single PEM Fuel cell test station
4. NEXA training system

Dr. FUEL CELL MODEL CAR

The Dr FuelCell® Model Car can be operated with energy from a fuel cell or a solar panel. A reversible fuel cell makes it possible to generate and store hydrogen wherever it is needed. Practical experiments help students easily understand the relationships between energy conversion, storage and consumption.

SOLAR HYDROGEN TECHNOLOGY SCIENCE KIT

The experimental setup mainly consists of solar module, load measurement box, electrolyser and Polymer Electrolyte Membrane fuel cell (PEMFC). In PEM fuel cell, hydrogen fuel is processed at the anode where electrons are separated from protons on the surface of a platinum-based catalyst. The protons pass through the PEM to the cathode side of the cell while the electrons travel in an external circuit, generating the electrical output of the cell. On the cathode side, another precious metal electrode combines the protons and electrons with oxygen to produce water. An electrolyser is used to supply hydrogen and oxygen to the PEM fuel cell. A 5-cell photovoltaic solar cell is used to supply electric current to electrolyser. A solar cell is a solid-state electrical device that converts the energy of light directly into electricity (DC). A load measurement box is used to measure the voltage and current produced from the PEM fuel cell.

SINGLE PEM FUEL CELL TEST STATION

Single PEM fuel cell test station consists of Humidifiers for hydrogen and oxygen with temperature controller up to 100°C, Rotameters for hydrogen flow rates (0-600 ml/min) and oxygen flow rates (0-1000 ml/min), Electronic load module with voltage range 0-2V and current range 0-15amps with Temperature controller to control the temperature up to 80°C.

The transparent PEMFC consist of membrane electrode assembly (MEA), gaskets, flow field plates, transparent cover plates and end plates. The MEA is composed of Nafion 212 membrane sandwiched between carbon fibres.

NEXA TRAINING SYSTEM

The Nexa® Training System is a modular fuel cell training system with an electrical rated output of 1.2 kW. The system is based on the Nexa® Power Module developed by the company Ballard Power Systems.

The Nexa® Training System consists of the following components:

1. Metal Hydride Storage Module
2. Fuel Cell Module
3. Power Management Module
4. Electronic Load Module
5. PC and software

1. **Metal Hydride Storage Module** It provides the hydrogen supply for the Nexa® Training System. The module contains 3 separate metal hydride storage canisters each with a hydrogen storage capacity of 760 SL (at .0 °C / 32 °F; 1013 bar).

2. **Fuel cell module**

- The Fuel Cell Module consists of the fuel cell stack itself, components for the hydrogen and air supply, a cooling system and the controller of the subsystem.

3. **Power management module**

- The Power Management Module is used for conversion of the electrical power output of the Fuel Cell Module.
- The integrated DC converter then converts this unregulated, load dependent direct voltage into a regulated, rated voltage of 24 V. The batteries integrated in the system via the rear panel battery connection make dynamic intermediate storage of the electrical energy possible. The direct voltage can be tapped using the DC power output on the front side.
- The integrated inverter produces a 230 V AC isolated network from the 24 V rated voltage.

- A 24 V start-up power voltage is provided for starting up and normal shutdown of the Fuel Cell Module by the start-up power output

4. **Electronic load module**

- Experiments which simulate practical applications can be performed using the Electronic Load Module and thus the behaviour of the fuel cell system can be examined for various practical examples.
- The electronic load can be operated manually or controlled by software.
- The electronic load can operate in constant current, constant resistance or constant power mode.

5. **PC and Nexa training system software**

- The PC is located in the lower part of the Nexa® Training System rack. The LCD monitor is mounted on a freely movable arm which is on the side of the rack.
- The following are installed on the PC:

Nexa® Training System software

NexaMon OEM software

- The NexaMon OEM software is only used for incoming diagnostics for exception errors
- Nexa® Training System software is primarily used for displaying the measured data. As an alternative to manual operation, you can also partially operate the Nexa® Training System using the PC.
- The Flow Chart Display is the main view of the software. In this view, all specific data of the system during operation and their value changes are displayed