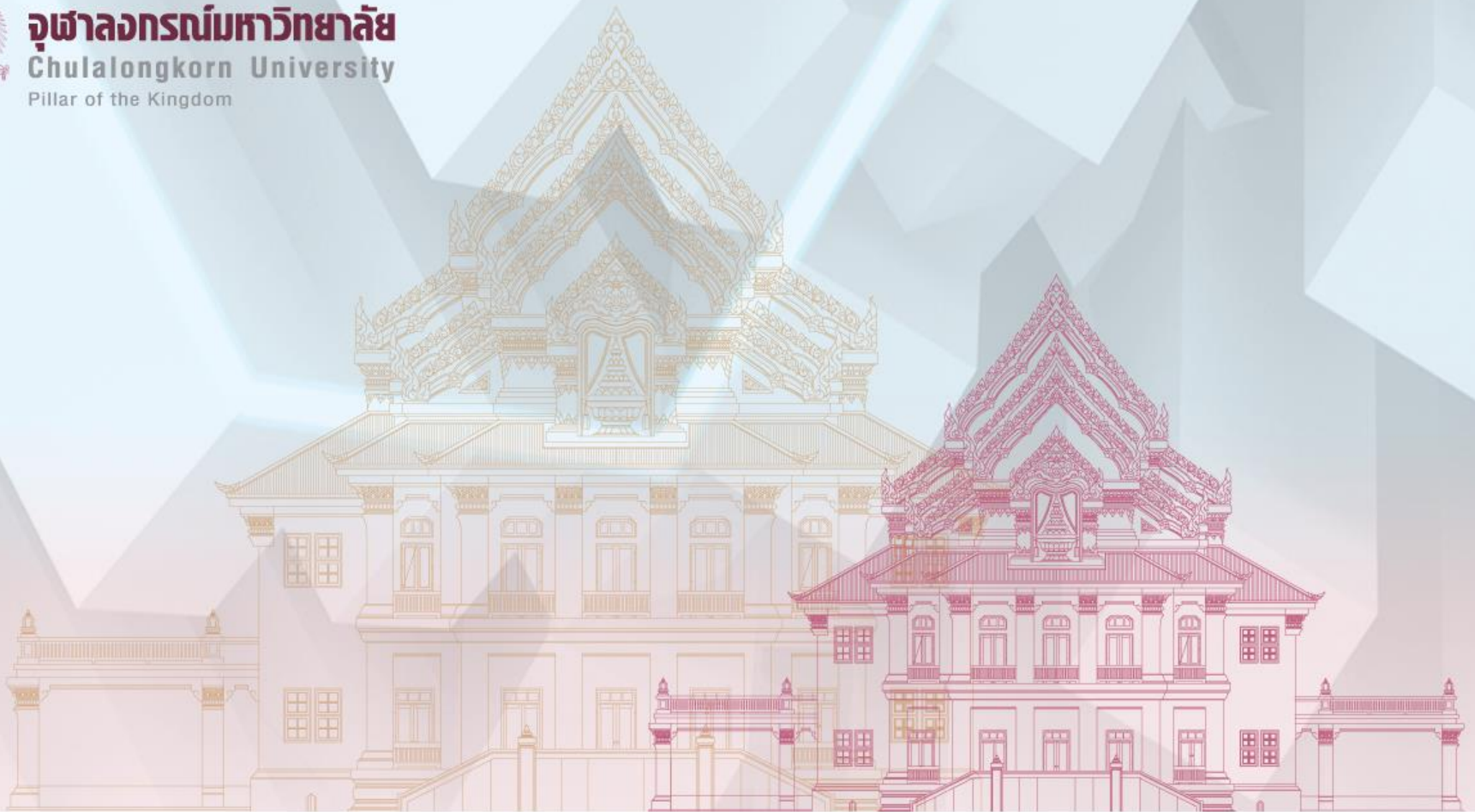




จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University
Pillar of the Kingdom



Seminar on Fuel Cells for Automotive Applications

Department of Chemical Technology

Dept. of Chemical Technology

- Established in 1959
- The department is striving for pursuing the excellence in research area of **Fuel** and **Energy Technology** together with maintaining the quality of the environment.



Faculty members

5 Professors



10 Assoc Professors



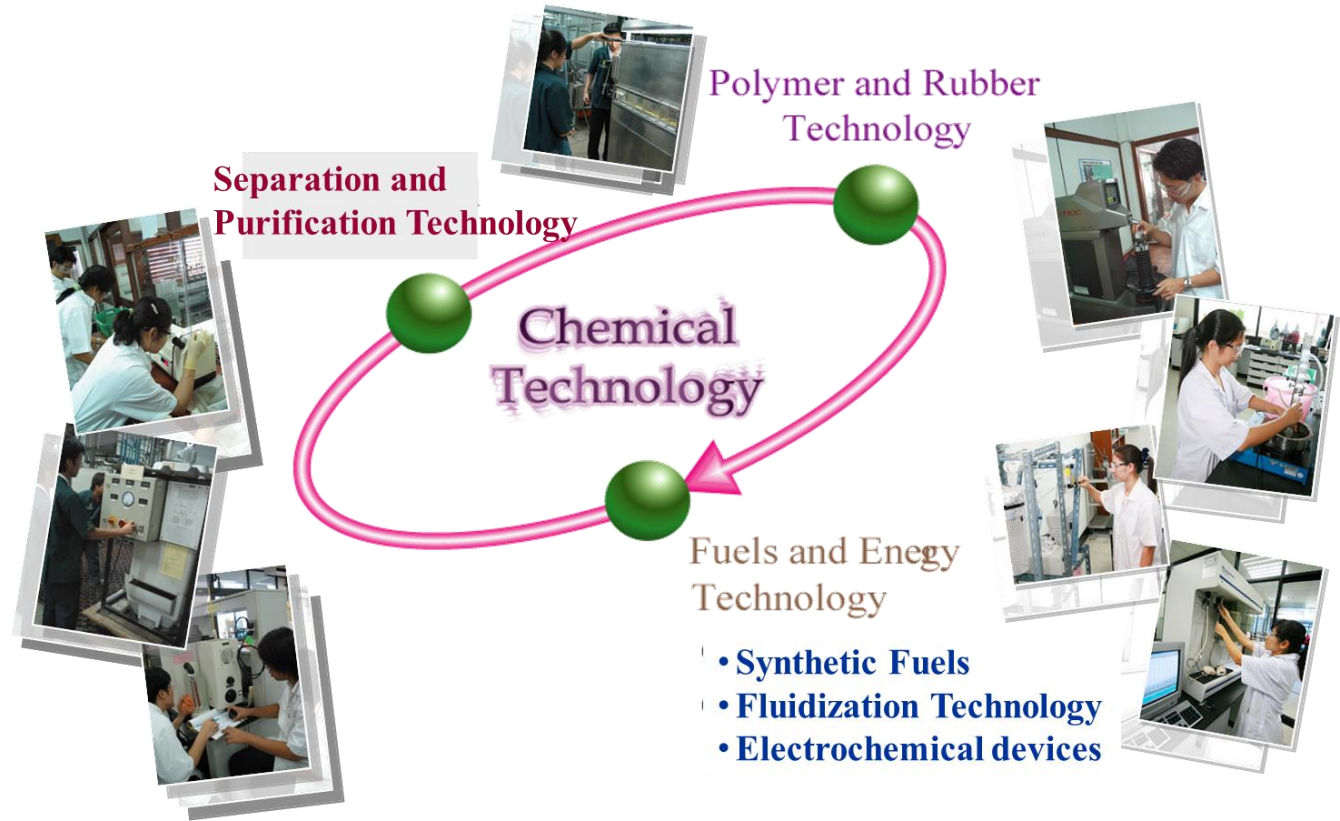
1 Asst Professor



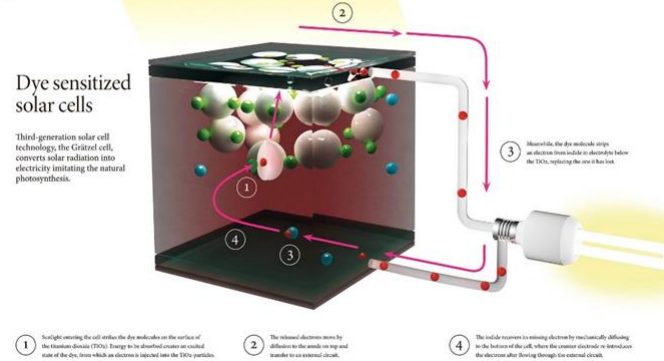
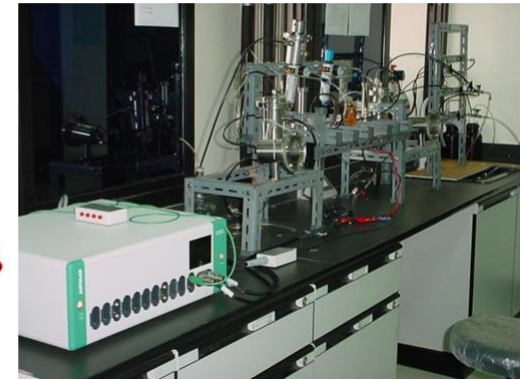
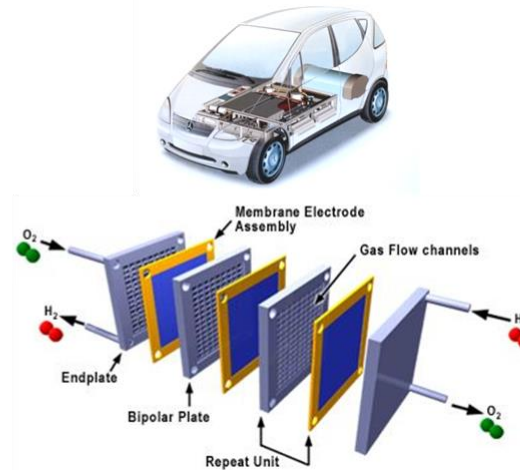
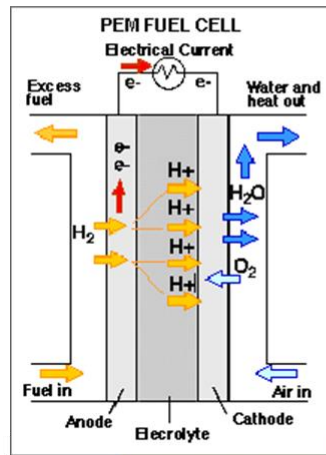
2 Instructors



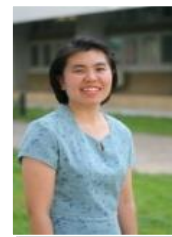
Research areas



Electrochemical devices Group



Members



Prof. Dr. Pornpote Piumsomboon

Prof. Dr. Mali Hunsom

Assoc. Prof. Dr. Kejvalee Pruksathorn

Assoc. Prof. Dr. Nattaya Pongstabodee

Assoc. Prof. Dr. Nisit Tantavichet

Dr. Nuttapol Pootrakulchot



Goal

- To develop expertise in electrochemical processes: such as fuel cell, photovoltaic cell and battery technologies and to support the knowledge and technology to the Thai society.



Objectives (1)

- ❖ To produce reliable and cost-effective fuel cells, including PEM fuel cell and DM fuel cell, using domestically available materials
- ❖ To develop novel techniques to improve the efficiency of batteries, such as valve-regulated lead-acid and Li-polymer batteries

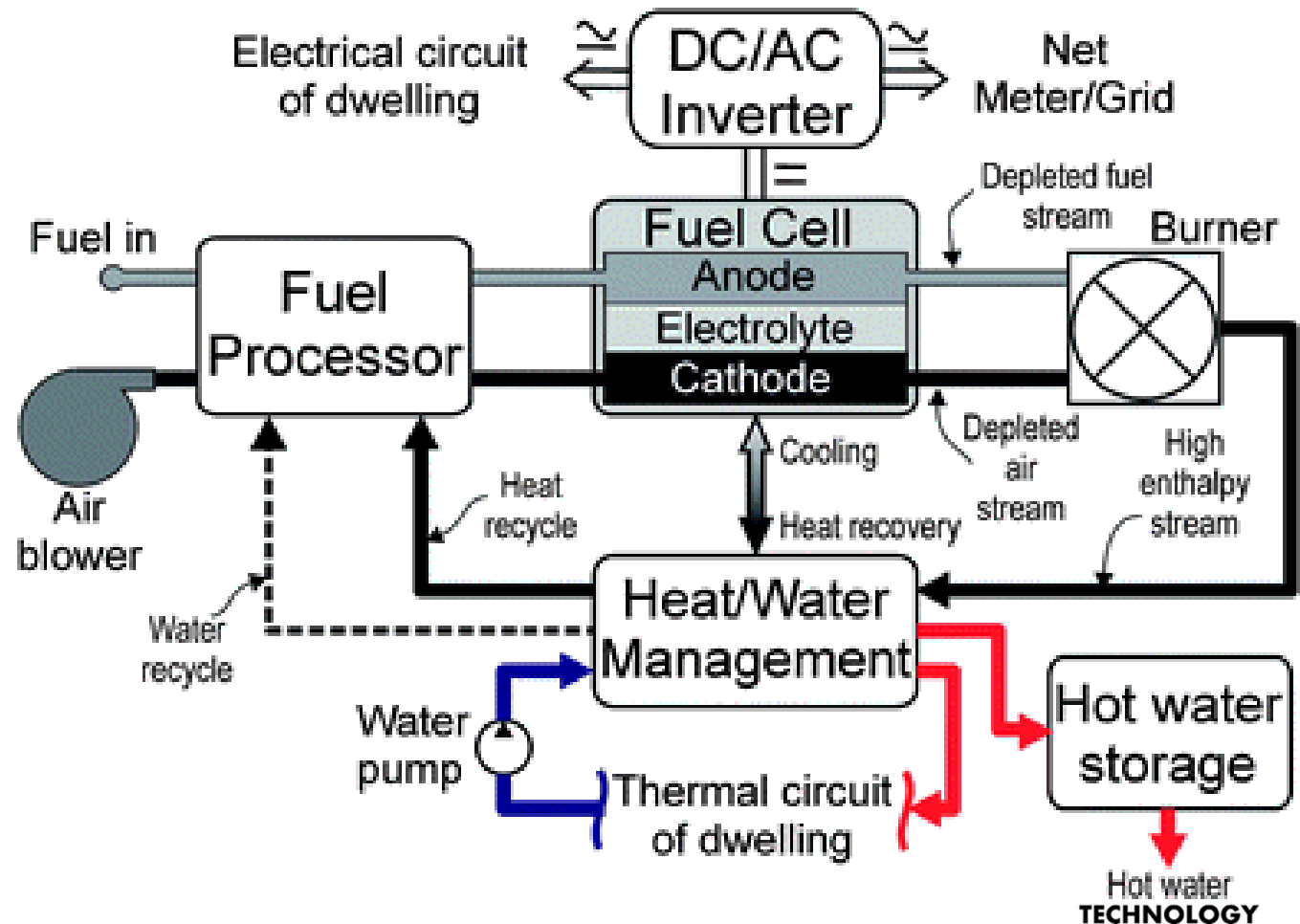


Objectives (2)

- ❖ To further enhance the overall energy conversion efficiency of dye-sensitized photovoltaic cells by improving their sensitizing capabilities as well as to develop the large scale devices based on this technology
- ❖ To develop skilled workforce for fuel cell, photovoltaic cell and battery industries and to instill environmental responsibility in them

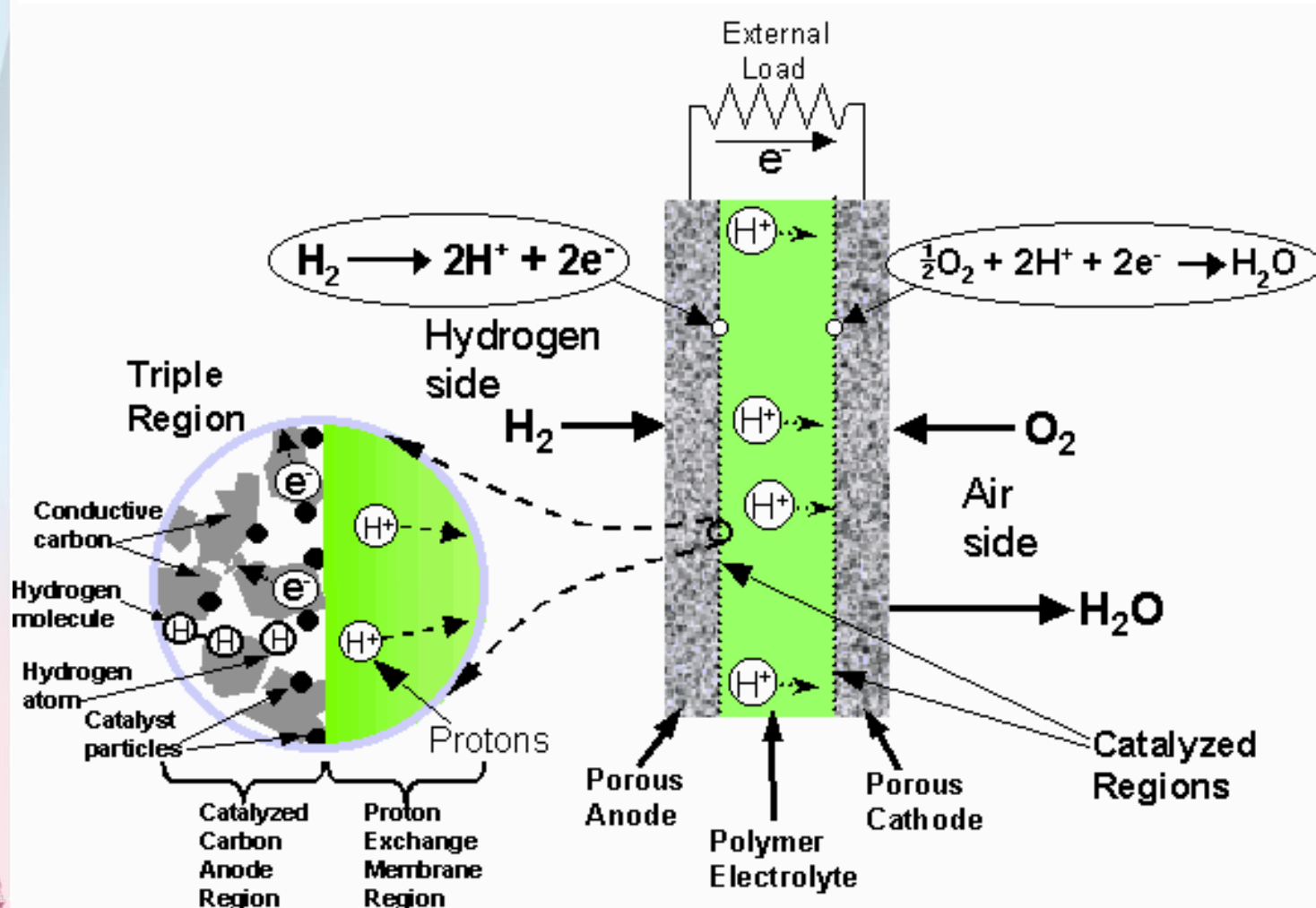


Fuel cell system



Source:

<http://pubs.rsc.org/is/content/articlelanding>



Source:

http://www.thirdorbitpower.com/PEM_mechanism.html

ORR catalyst development

- Electrocatalytic activity of Pt-Pd electrocatalysts for the oxygen reduction reaction in proton exchange membrane fuel cells: Effect of supports
- Effect of MO (M = Ce, Mo, Ti) layer on activity and stability of PtCo/C catalysts during an oxygen reduction reaction
- Stability of TiO Promoted PtCo/C catalyst for oxygen reduction reaction
- Incorporation of TiO into the PtPd/C catalyst layer for improvement ORR activity and water management
- Activity and stability of Pt Cr/C catalyst for oxygen reduction reaction: Effect of the Pt: Cr ratio and heat treatment atmosphere



HOX catalyst development

- Applying a face-centered central composite design to optimize the preferential CO oxidation over a PtAu/CeO₂-ZnO catalyst
- Preferential oxidation of carbon monoxide in simulated reformed gas over PtAu/Ce_xZn_yO₂ catalysts
- Catalytic performances of Pt-Pd/CeO₂ catalysts for selective CO oxidation
- Preferential oxidation of carbon monoxide over Pt, Au monometallic catalyst, and Pt-Au bimetallic catalyst supported on ceria in hydrogen-rich reformat
- Selective oxidation of CO to CO₂ over Cu-Ce-Fe-O composite-oxide catalyst in hydrogen feed stream

MEA preparation

- Optimum Condition of Membrane Electrode Assembly Fabrication for PEM Fuel Cell
- Novel application of Hicon Black in PEMFC microporous sublayer:
- Identification of the key variables in membrane electrode preparation for PEM fuel cells by a factorial design

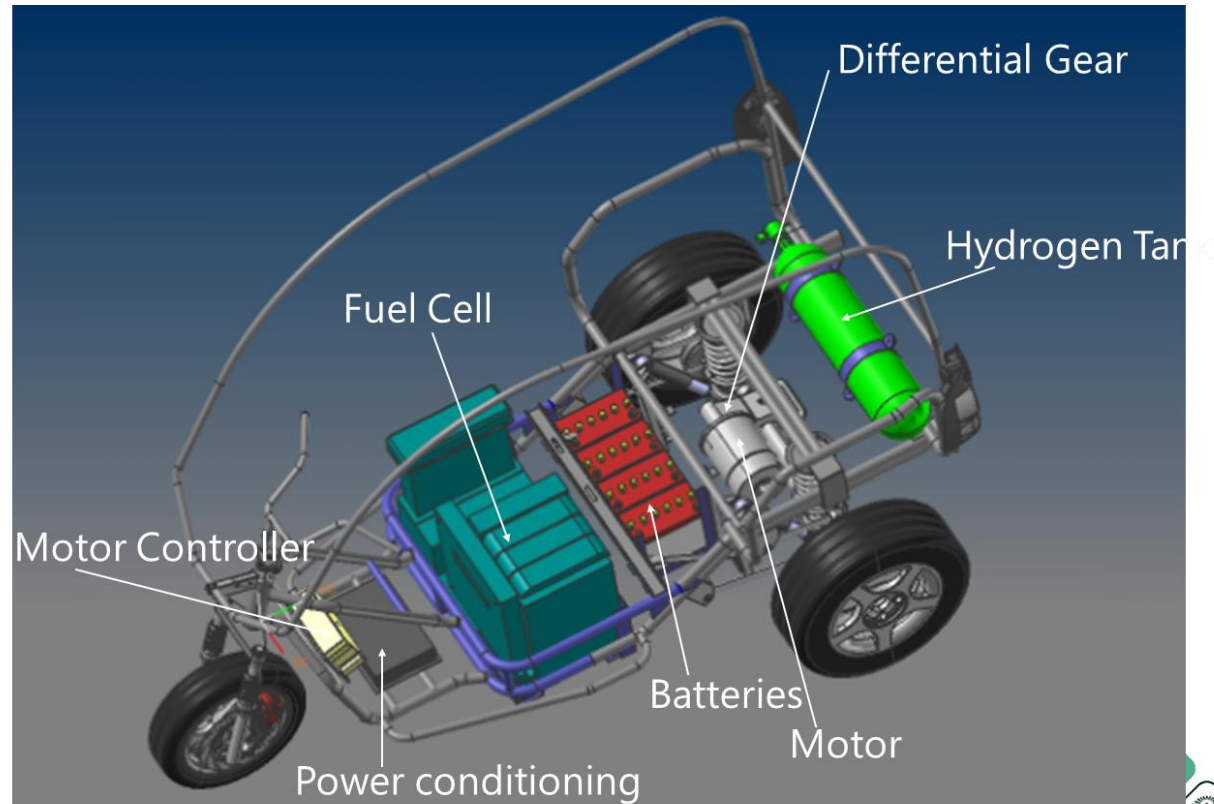
Electrode preparation

- Sublayers for Pt catalyst electrodeposition electrodes in PEMFC
- Catalyst electrode preparation for PEM fuel cells by electrodeposition
- Preparation of Pt/C catalysts by electroless deposition for proton exchange membrane fuel cells
- Pulse reverse electrodeposition of Pt-Co alloys onto carbon cloth electrodes
- Preparation of Pt-Co alloy catalysts by electrodeposition for oxygen reduction in PEMFC

Fuel cell system studies

- Geometry and pattern of gas flow channel on the performance of PEM fuel cell
- 200W PEM Fuel Cell Stack with Online Model-Based Monitoring System
- Road testing of a three-wheeler driven by a 5 kW PEM fuel cell in the absence and presence of batteries
- Effect of Channel Designs on Open-Cathode PEM Fuel Cell Performance: A Computational Study

Fuel Cell Vehicle



- Supported by DEDE, MOE

H₂ production

- Optimization of methanol steam reforming over a Au/CuO-CeO₂ catalyst by statistically designed experiments
- Hydrogen production via methanol steam reforming over Au/CuO, Au/CeO₂, and Au/CuO-CeO₂ catalysts prepared by deposition-precipitation
- The activities of Cu-based Mg–Al layered double oxide catalysts in the water gas shift reaction
- Statistical optimization by response surface methodology for water-gas shift reaction in a H₂-rich stream over Cu-Zn-Fe composite-oxide catalysts

Batteries

- Polyaspartate as a gelled electrolyte additive to improve the performance of the gel valve-regulated lead-acid batteries under 100% depth of discharge and partial-state-of charge conditions
- Influence of fumed silica and additives on the gel formation and performance of gel valve-regulated lead-acid batteries
- Gelled electrolytes for use in absorptive glass mat valve-regulated lead-acid (AGM VRLA) batteries working under 100% depth of discharge conditions

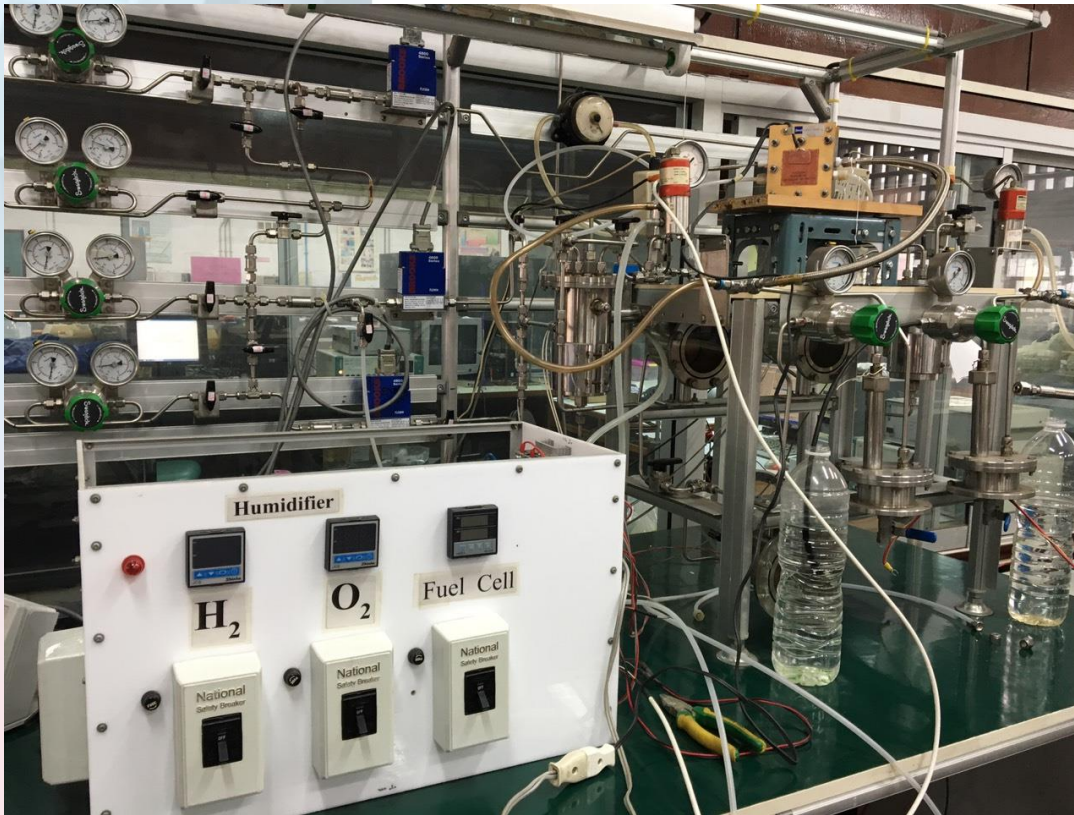


Dye-sensitized solar cell

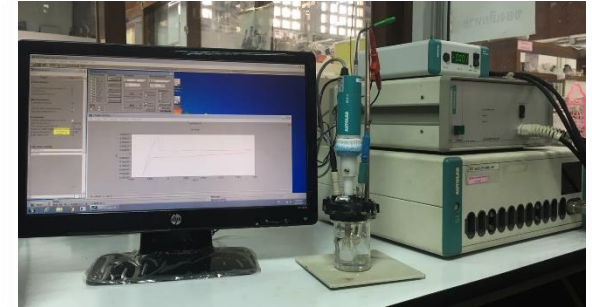
- A polydiacetylene-nested porphyrin conjugate for dye-sensitized solar cells
- Porphyrin containing lipophilic amide groups as a photosensitizer for dye-sensitized solar cells
- Photosensitizing triarylamine- and triazine-cored porphyrin dimers for dye-sensitized solar cells
- A new heteroleptic ruthenium sensitizer for transparent dye-sensitized solar cells



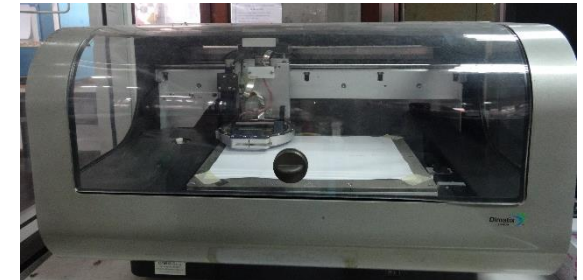
Facilities



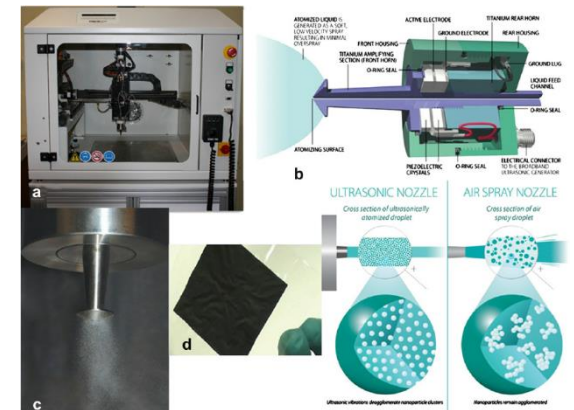
Fuel cell test station



Potentiostat PGstat 30



Inkjet printer



Ultrasonic spray

Outputs

International publications: > 40

Research projects: > 15

- Thailand Research Fund (TRF)
- Energy Policy and Planning office (EPPO)
- National Research Council of Thailand (NRCT)
- Department of Alternative Energy Development and Efficiency (DEDE)



Collaborations

Ecole Nationale Supérieure des Ingénieurs en Arts Chimiques Et Technologiques, France

Department of Chemical Engineering, Curtin University, Australia.

University of Innsbruck, Austria

Yonsei University, Korea

Department of Electrical Engineering, Chulalongkorn University

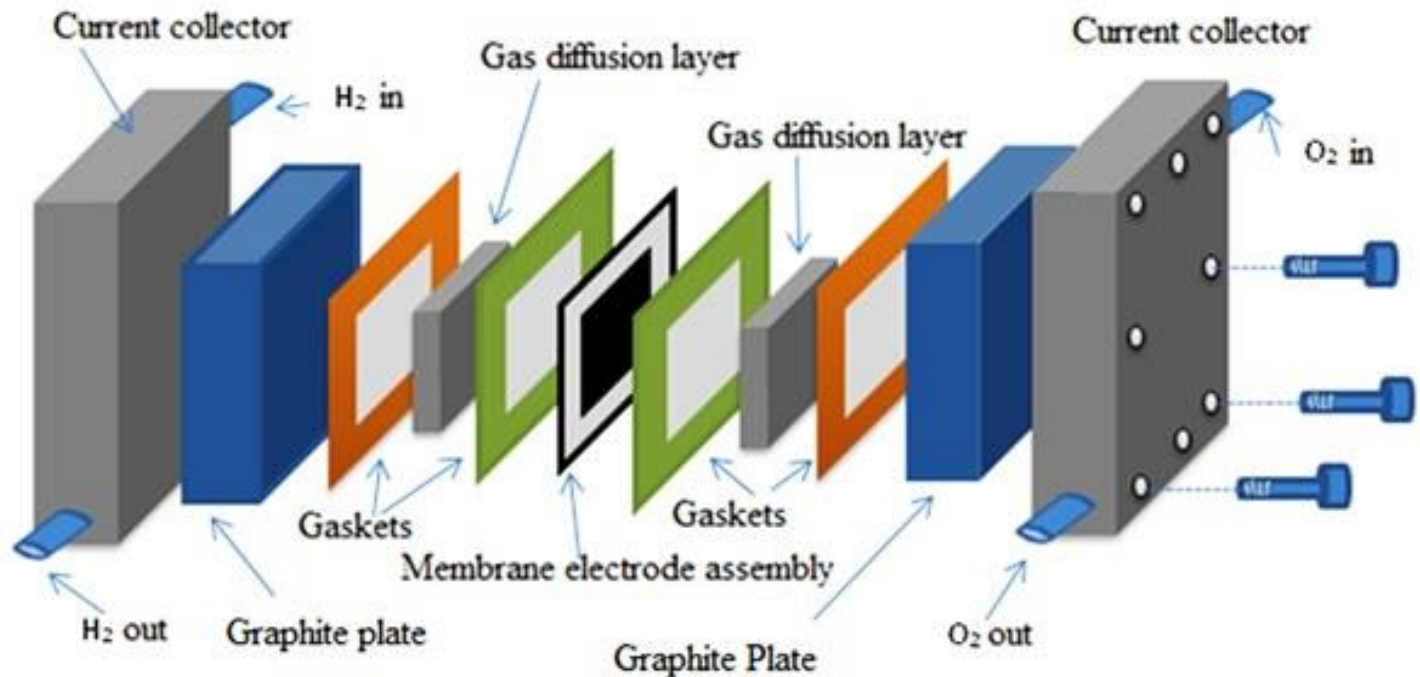
Department of Mechanical Engineering, Chulalongkorn University



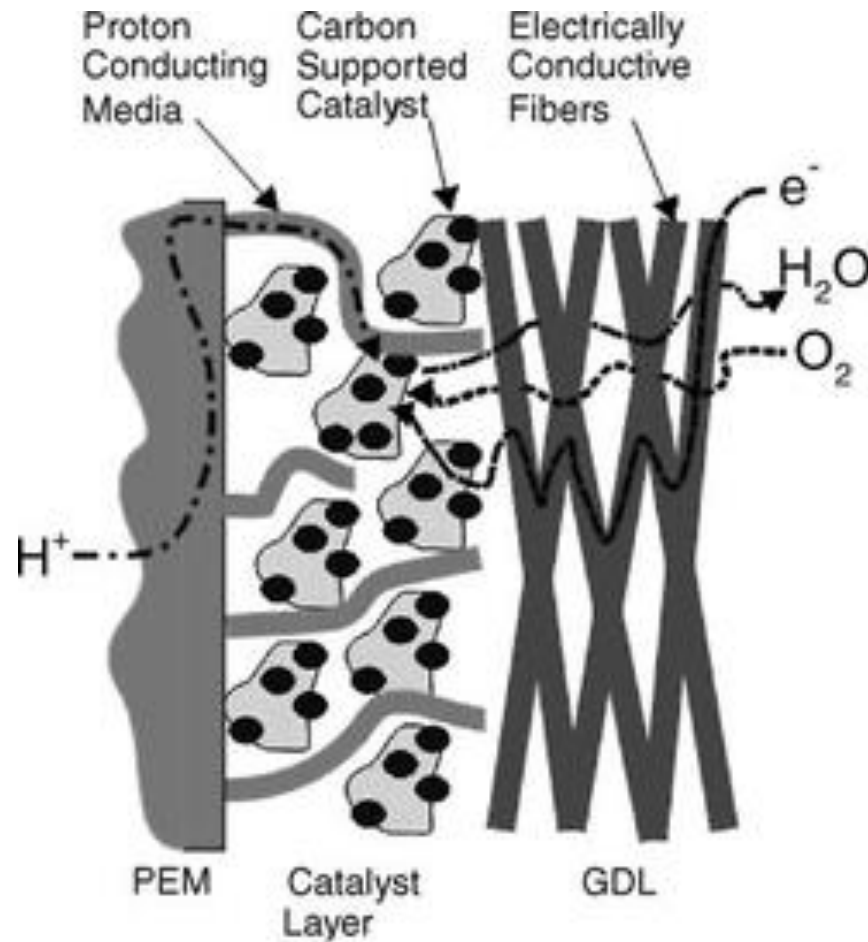
Thank you for your attention



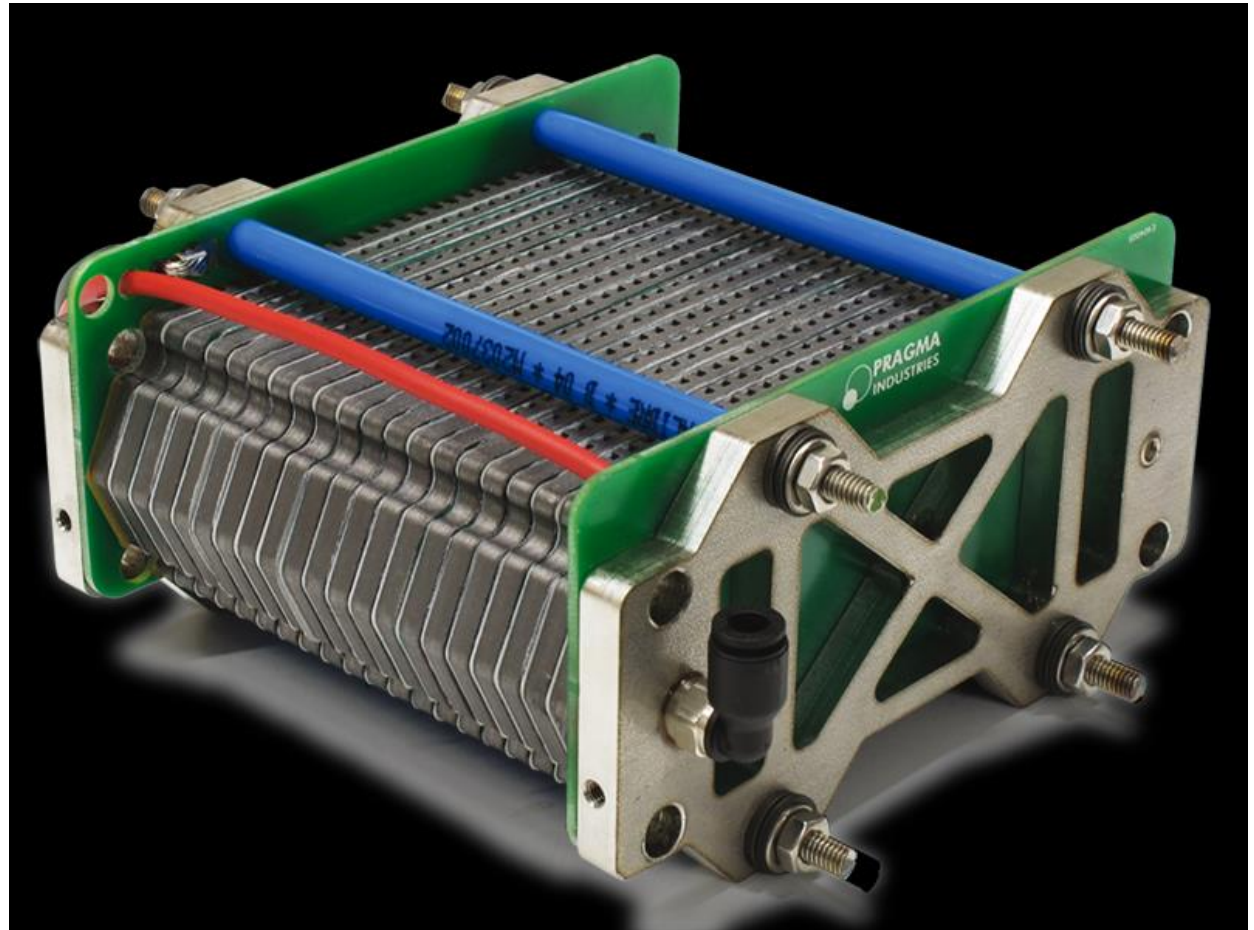
PEM fuel cell



Fuel cell zoom in



Fuel cell stack



TECHNOLOGY

Source

<http://www.pragma-industries.com/products/ocs/>

PEM fuel cell

