國立清華大學
National Tsing Hua University

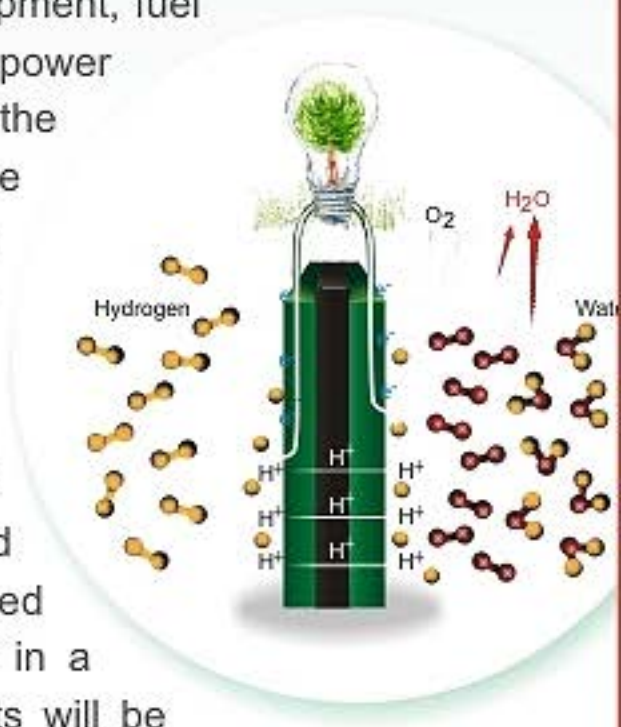
College of Nuclear Science

International Ph.D. Program in Low Carbon Energy

International Ph.D. Program in Low Carbon Energy

Introduction

The International Ph.D. Program in Low Carbon Energy is provided by the College of Nuclear Science, National Tsing Hua University. Low carbon energy has been adopted as a primary energy source for alleviating the impact of the greenhouse effect. Among the options practically available, nuclear energy, solar energy, wind power, and hydrogen energy are targeted with worldwide attention. Nuclear energy with a thermal efficiency of more than 30% is competitive with that of a commercial fossil plant. With the nature of almost zero carbon emission, nuclear energy is deemed as a potential and practical solution to the control of the greenhouse effect. Solar energy is currently undergoing intensive research worldwide for efficiency improvement. To effectively exploit the abundant thermal and electromagnetic energy provided by the sun, it is essential that energy conversion devices with a relatively high efficiency should be developed. In addition to direct combustion, hydrogen energy may be utilized via various types of fuel cells. After more than fifty years of development, fuel cells now show promising potentials for applications in modular power stations, electric vehicles, and portable electronic devices, with the aid of nanotechnology. Though environmentally friendly, the foregoing options of low carbon energy still have challenges to overcome, in the aspects of nuclear safety, energy conversion efficiency, and power density improvement.



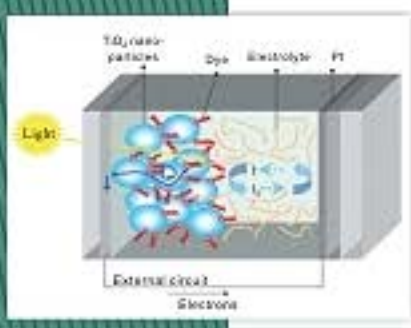
The goal of low carbon energy discipline is to explore advanced scientific basis and technology breakthrough in these energy systems. In addition to discussion on the principles and applications, novel research results and newly developed technologies pertinent to the subject areas will be reviewed in a timely manner. Upon the completion of this program, students will be able to fully understand the in-depth nature of low carbon energy, to identify the pros and cons of these energy technologies, and to capture the global trend of their future development. All lectures in this program are offered in English for international students.

◀ THOR-BNCT

(Tsing Hua Open-pool Reactor "Boron Neutron Capture Therapy") facility.

THOR was renovated for an epithermal neutron beam for BNCT purpose. The renovation was completed in May 2004. Starting August 2010, the beam has been used for clinical trials of recurrent head-and-neck(H&N) cancer under collaboration with Taipei Veteran General Hospital.

BNCT is essentially a "target" heavy ion therapy. For certain cancers which are difficult to treat with existing traditional therapy, such as recurrent H& N cancer, BNCT provides another choice for the patient.



◀ DSCs are solar cells that copying nature's own energy-conversion process could constitute the next generation of green energy-generating sources.

Based on photosynthesis, in which plants transform the sun's rays into stored energy, mesoscopic injection solar cells offer credible and attractive alternatives to solid-state p-n junction devices. These relatively new nanocrystalline photovoltaic devices invented in the early 1990s, promise viable solutions to future large-scale solar-energy conversion issues on the bases of cost, efficiency, stability, availability, and environmental compatibility.

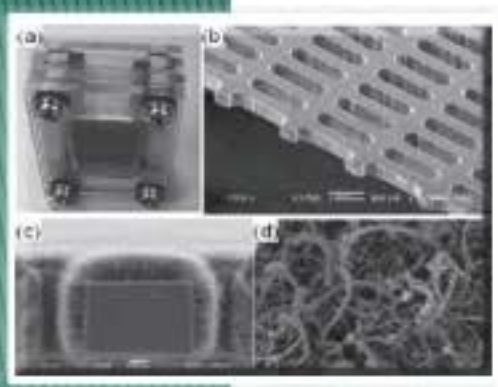
International Ph.D. Program in Low Carbon Energy

Research Fields

In conjunction with the goal of the Low Carbon Energy Program, a number of corresponding research subjects are being studied at College of Nuclear Science with sufficient funding supports from the university, the industry, and the government. For nuclear energy, faculty members with expertise in reactor physics, reactor thermal hydraulics, reactor safety, fuel management, and nuclear materials are currently conducting research projects in the corresponding areas and are offering research assistantship to prospective Ph.D. students. For solar energy, outstanding research groups are working on both inorganic solar cells and organic solar cells, in the areas of novel catalyst preparation, cell design, processing, and assembling. Students carrying out theses research in this energy field will be financially supported by related research projects. For hydrogen energy, research is mainly focused on hydrogen production and storage and low-temperature fuel cells. Hydrogen production via low-temperature reformers or high-temperature nuclear iodine-sulfur processes, effective physical and chemical storages of hydrogen, and micro-scale fuel cells for portable electronic devices are being investigated by quite a number of faculty members. All Ph.D. students in the research field of hydrogen energy are also financially supported.

Research Focus

- Reactor Physics
- Reactor Thermal Hydraulics
- Reactor Safety
- Fuel Management
- Nuclear Materials
- Inorganic Solar Cells
- Organic Solar Cells
- Catalyst, Electrolyte, and Electrode Preparation
- Solar Cell Design
- Solar Cell Processing
- Solar Cell Assembling
- Hydrogen Production via Low-Temperature Reformers
- Hydrogen Production via High-Temperature Nuclear Iodine-Sulfur Processes
- Effective Physical and Chemical Storages of Hydrogen
- Micro-Scale Fuel Cells

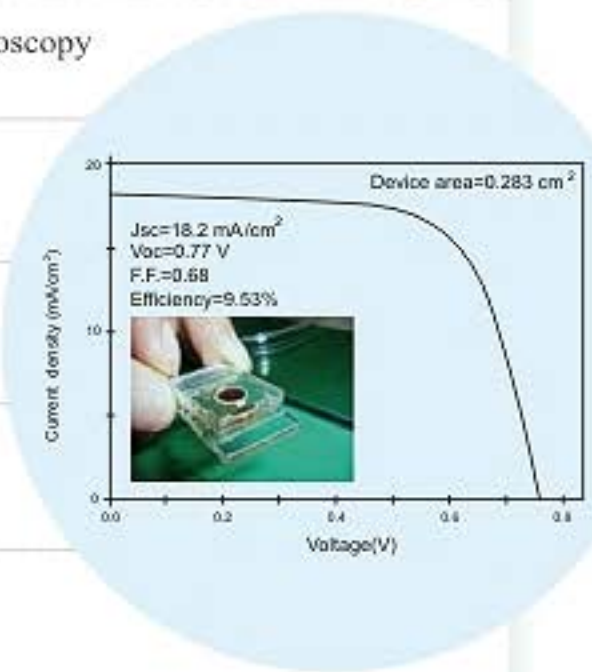


◀ Micro Fuel cell

A micro fuel cell bears a relatively high energy density to sustain a long-hour operation (more than one week) when used in cell phones and laptop computers. Methanol replenishment instead of charging is needed for reviving the fuel cell in a relatively short time. The packaged micro fuel cell (a) and the micro-array structure (b) ,the carbon nanotube structure (c) ,and the platinum nano-particles on carbon nanotubes (d) in the reaction zones of the micro fuel cell are shown in the figure.

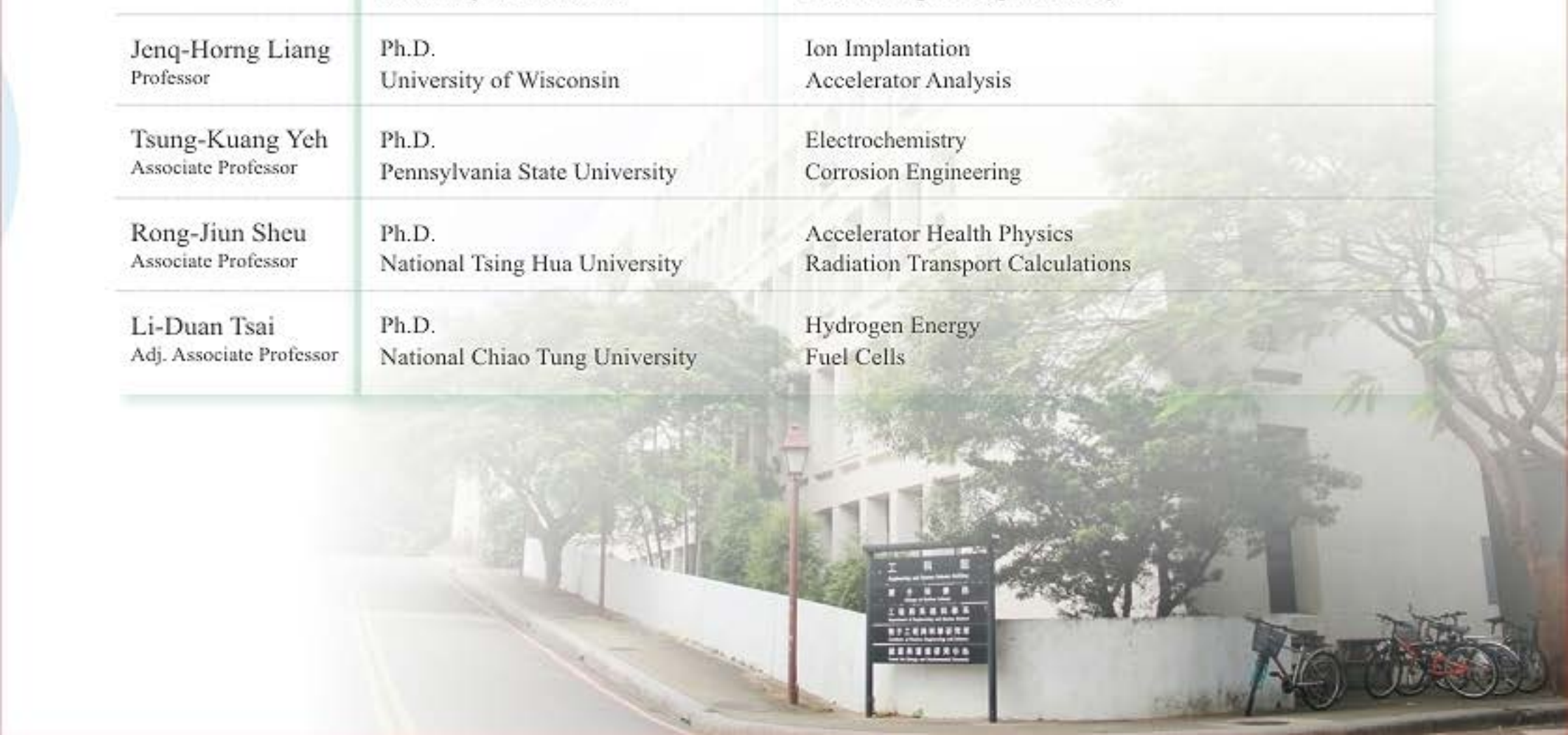
Faculty Members

Name/Position	Degree	Research Field
Fan-Gang Tseng Professor	Ph.D. University of California, Los Angeles	BioNEMS Nano/Micro Fluidics
Chuen-Horng Tsai Professor	Ph.D. University of California, Berkeley	Corrosion and Stress Corrosion Plasma and Semiconductor Processing
Hwai-Pwu Chou Professor	Ph.D. Purdue University	IC Design Nuclear Electronics and Instrumentation
C. Lin Professor	Ph.D. University of California, Berkeley	Intelligent Computing Design and Application Nuclear Power Plant Feul Management
T. K. Wang Professor	Ph.D. Purdue University	Semiconductor Trace Analysis Neutron Activation Analysis
G. S. Chen Professor	Ph.D. University of Cincinnati	Neutron Transport Plasma Numerical Simulation
Chin Pan Professor	Ph.D. University of Illinois	Two-Phase Flow Heat and Fluid Flow in Micro System
Tsang-Lang Lin Professor	Ph.D. Massachusetts Institute of Technology	Small-Angle Neutron and X-Ray Scattering Neutron and X-Ray Reflectivity
W. K. Lin Professor	Ph.D. University of Maryland	Thermal and Fluids Systems Two-Phase Flow
M. Lee Professor	Ph.D. Massachusetts Institute of Technology	Two-Phase Flow System Reliability Evaluation
Jia-Hong Huang Professor	Ph.D. University of Illinois	Mechanical Properties of Materials Thin Film Processing
Fu-Rong Chen Professor	Ph.D. State University of New York Stony Brook	High Resolution Electron Microscopy Electron Optics
K. C. Leou Professor	Ph.D. University of California, Los Angeles	Plasma Processing Plasma Physics
K. S. Chang-Liao Professor	Ph.D. National Taiwan University	VLSI Device Non-Volatile Memory
C. C. Chieng Professor	Ph.D. Virginia Polytechnic Institute and State University	Micro System Heat Transfer
J. J. Kai Professor	Ph.D. University of Wisconsin	Nano-Materials and Devices Nano-Structure Analysis
Yung-Chun Wu Associate Professor	Ph.D. National Chiao Tung University	Flat-Panel Display Device Physics and Fabrication Technology Nano Optoelectronic Device Physics and Fabrication Technology
Yuh-Ming Ferng Associate Professor	Ph.D. National Tsing-Hua	Safety Operation and Maintenance Analysis Fire Hazard Analysis



Faculty Members

Name / Position	Degree	Research Field
Y. Hu Associate Professor	Ph.D. Princeton University	Plasma Physics Controlled Fusion Theory
Yu-Chuan Su Associate Professor	Ph.D. University of California, Berkeley	Nano/Micro Electro-Mechanical System Design
Pai-Yi Hsiao Associate Professor	Ph.D. Universite Paris 7 – Denis Diderot	Soft Matter Physics Molecular Simulation
Yung-Hsien Wu Associate Professor	Ph.D. National Chiao Tung University	SiGe and Ge MOSFET Memory Process Development
Chih-Wen Lu Associate Professor	Ph.D. National Chiao Tung University	LCD Driver IC Design Analog-to-Digital Converter Design
Pen-Cheng Wang Assistant Professor	Ph.D. University of Pennsylvania	Polymer Science Functional Polymeric Interfaces and Nanomaterials
Fan-Yi Ouyang Assistant Professor	Ph.D. University of California, Los Angeles	Reliability in microelectronic packaging Electromigration
S. H. Jiang Professor	Ph.D. University of Karlsruhe, Germany	Radiation Shielding Radiation Measurement
Chunkuan Shih Professor	Ph.D. in Nuclear Eng., University of Wisconsin	Heat Transfer and Fluid Mechanics Nuclear Power Plant Safety Analysis
Yen-Wan Hsueh Professor	Ph.D. Columbia University	Reactor Physics and Shielding Analysis Neutron Cross Sections
G. P. Yu Professor	Ph.D. Massachusetts Institute of Technology	Nano-Materials Energy Materials
B. S. Pei Professor	Ph.D. University of Cincinnati	Two-Phase Flow and Boiling Heat Transfer Reactor Engineering and Safety
Jenq-Horng Liang Professor	Ph.D. University of Wisconsin	Ion Implantation Accelerator Analysis
Tsung-Kuang Yeh Associate Professor	Ph.D. Pennsylvania State University	Electrochemistry Corrosion Engineering
Rong-Jiun Sheu Associate Professor	Ph.D. National Tsing Hua University	Accelerator Health Physics Radiation Transport Calculations
Li-Duan Tsai Adj. Associate Professor	Ph.D. National Chiao Tung University	Hydrogen Energy Fuel Cells



Curriculum

The 18 required credits (with the core courses), qualify exam, two SCI published manuscripts are necessary to receive the certificate. Please see the curriculum brochure of ESS for more information.

Designated Courses

Subjects	Instructors	Credits
Reactor Physics I	Jenq-Horng Liang Yen-Wan Hsueh	3
Nuclear Reactor Engineering	Chunkuan Shih	3
Management of Backend of Nuclear Fuel Cycle	Hong-Nian Jow	3
Semiconductor Devices Physics	K.S. Chang-Liao	3
Principles and Applications of Solar Energy	Jyh-Ming Ting	3
Engineering Electrochemistry	Pen-Cheng Wang	3
Hydrogen Energy and Fuel Cell Technologies	Li-Duan Tsa	3
Nuclear Safety	M. Lee	3
Molecular Dynamics Simulation	Pai-Yi Hsiao	3
Advanced Nanoelectronic Devices	Yung-Chun Wu	3

Assistantship

All students accepted for this program will be financially supported via research assistantship. Current offer is 20,000 NTD/month for half-time research assistants. Please note that tuition waive is not included in the assistantship offer.

Application

Applications to the International Ph.D. Program in Low Carbon Energy are due by **March 15** (Fall/September semester) **and November 1** (Spring/February semester).
For more information or to send supplemental documents, please use the following address :

Office of Global Affairs

- Tel: +886-3-5162461
- Email: oga@my.nthu.edu.tw
- http://oga.nthu.edu.tw/

Contact Us

Department of Engineering & System Science
No. 101, Section 2, Kuang-Fu Road, Hsinchu, Taiwan 30013, R.O.C.
Tel: +886-3-5742663 Fax: +886-3-5720724
http://www.ess.nthu.edu.tw