



Sustainable Chemical Science and Technology Program (SCST)

Taiwan International Graduate Program (TIGP)

Academia Sinica has established the Taiwan International Graduate Program (TIGP) in collaboration with a consortium of several key research universities in Taiwan. The purpose of the program is to develop the research manpower pool in those modern multidisciplinary fields that are important in the future economical and social development and to enhance the innovative potential and academic standards of research in these and related fields.

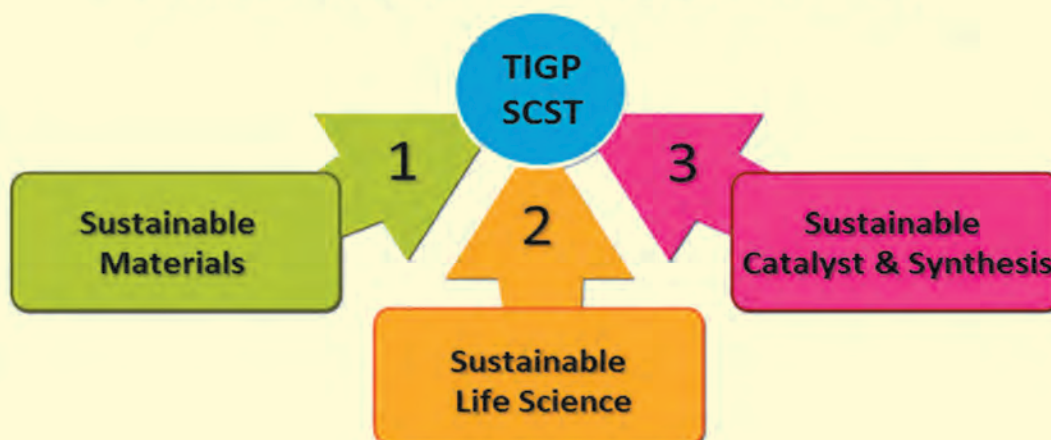
TIGP offers Ph.D. programs in only selected disciplines to be agreed upon between Academia Sinica and these research universities. It is the intent of the Program to offer Ph.D. education programs only in inter-disciplinary areas in the physical sciences, applied sciences, engineering, biological and agricultural sciences, health and medical sciences, and humanities and social sciences.

Academia Sinica assumes principal oversight of the academic options of the Program, and provides the intellectual leadership, the research resources, and the research and physical facilities. Qualified faculty members of the participating research universities are involved in various programs as affiliated faculties of the Program, and participate in the teaching of courses, supervision of research, and mentoring of the international graduate students.

TIGP Program on Sustainable Chemical Science & Technology

Within this context, the international Ph.D. program of Sustainable Chemical Science and Technology is designed to offer specific training and research opportunities to Ph.D. students who are interested in the following areas: 1. develop optoelectronic materials and their applications related to sustainable energy, 2. construction of supramolecular materials for recognition, self-assembly, and identification of chemical species, 3. new drug development related to human diseases, 4. understanding of disease mechanisms, 5. study in cell structure and function, 6. development of biosensors, 7. green technology of organic synthesis, 8. energy related catalysis, 9. technology for environmental monitoring and therapy. This program is a collaborative effort between Academia Sinica and National Chiao Tung University. In accordance with these research areas, the sustainable chemical science and technology program is divided into three categories, namely, sustainable materials, sustainable life science and sustainable catalyst & synthesis. The number of total students admitted to Sustainable Chemical Science and Technology Program every year is limited to twenty. The bulk of these students are international students with reasonable proficiency in the use of the English language. However, highly qualified Taiwanese students (up to 10 people) with adequate English proficiency are also considered. Students may do their thesis research with faculty whose principal appointments are associated with the National Chiao Tung University.

Sustainable Chemical Science and Technology





A whole array of laboratory equipments and facilities for teaching and research are available within the participating units. The following is a list of some examples -- device fabrication facilities: NMR Spectrometers: 200MHz, 300MHz, 2x400MHz, 500MHz, 600MHz and a 300 MHz Solid state, Mass Spectrometers: GC/MS, Ion Trap, Q-TOF, ESI-TOF, Sector, MALDI-TOF/TOF, Single Crystal X-ray Diffractometer & Powder X-ray Diffractometer, Microscopes: AFM, STM, SEM, and TEM, Dip-pen Nanolithography System, EPR Spectrometer with ESEEM, ENDOR, and Time-resolved Measurements, ESCA/XPS/Auger Spectrometer, Magnetic CD, Physical Vapor Deposition System, Solar Cell Measurement System, SQUID, Ultra-high Speed Centrifuges.

Together with the above facilities, diverse expertise, and, more importantly, close collaboration among scientists and engineers of all participating units, the present graduate program provides students with an excellent opportunity to cultivate their research interests, and to develop their creativity and skills in problem defining and problem solving.

Collaboration Institutions

Academia Sinica

Institute of Chemistry (<http://www.chem.sinica.edu.tw/>)

Institute of Earth Sciences (<http://www.earth.sinica.edu.tw/>)

Research Center for Environmental Changes (<http://www.rcec.sinica.edu.tw/>)

Agricultural Biotechnology Research Center (<http://abrc.sinica.edu.tw/>)

Institute of Biological Chemistry (<http://www.abc.sinica.edu.tw/>)

National Chiao Tung University

Sustainable Chemical Science and Technology Program (<http://www.ac.nctu.edu.tw/main.php>)

Partner Institutions at National Chiao Tung University

Department of Applied Chemistry

The Department of Applied Chemistry was established in 1982, starting with Master Program to cope with the nation's increasing demand for experts in the fields related to applied chemistry. In 1991, B.S. program was added. Since 1992, Ph. D. education has been offered. Now, the department is one of the leading research institutes and provides students with excellent education in advanced topics related to fundamental and applied chemistry in the country. The department has 29 full-time faculty members and several adjunct appointments. The department is well funded by both governmental and industrial agencies. The faculty members now carry out interdisciplinary research projects in the six major categories. More specifically, these include drug design and synthesis, supramolecular chemistry, photochemistry, enzyme chemistry, protein engineering, micro-fluidic analysis, bio-analysis, single molecular detection, molecular dynamics, laser chemistry, ultra-fast kinetics, nano-materials, photoelectronic materials, polymer materials, polymer science and technology, materials for energy regeneration and storage, computer simulation and theoretical calculation.

Institute of Molecular Science (IMS)

The Institute of Molecular Science (IMS) was established in 2005 for the purpose of training excellent graduate students and researchers and integrating research groups for frontier interdisciplinary research. IMS welcomes students in physics, chemistry, biosciences, materials, photonics, and other related disciplines to join its graduate program. The academic staff in IMS include three Academicians (S. H. Lin, M. C. Lin, and Y.-P. Lee) of Academia Sinica. IMS is also highly international, with many members of academic staff from Japan and other countries, including H. Masuhara (Foreign member of Belgium Academy of Sciences and The India National Academy of Sciences, Fellow of Japanese Chemical Society) who is leading the Laser Bio/Nano Science Laboratory and H. Hamaguchi (Fellow of Society for Applied Spectroscopy, USA) who is directing the Ultimate Spectroscopy and Imaging Laboratory. IMS focuses on five major research directions to develop a unique interdisciplinary program for frontier fundamental research involving physics, chemistry, biotechnology, photonics and material science.

Research Topics

Sustainable Materials:

- **Develop optoelectronic materials and their applications related to sustainable energy**

Optoelectronic materials aiming for energy-saving or energy conversion is one of primary goals of the SCST program in TIGP. Developing materials for white organic light-emitting diodes (WOLEDs) in lighting application is one way to achieve energy-saving compared with traditional lighting method. For effectively utilizing solar energy, organic material-based solar cells including organic photovoltaic (OPV) and dye sensitized solar cell (DSSC) are alternatives in the conversion of photo energy to electrical energy. Molecular electronics, such as organic transistor/memory devices, requires judicious design of organic semiconductive materials for manipulating electrical current and saving energy.

- **Construction of supramolecular materials for recognition, self-assembly, and identification of chemical species**

Self-assembly of nanometer-scale inorganic materials having metal organic framework (MOF) is one typical approach of preparing supramolecular materials to serve the purpose. Design, synthesize, and identify organic gelating materials are effective way in generating novel supramolecular materials. The corresponding ratiometric or fluorescent recognition of chemical species is an analytical sensing method for protecting environment, a practical realization of green chemistry.

Sustainable Life Science:

- **New drug development related to human diseases**

Drug discovery in antimetastatic and antiproliferative agents; (2) New therapeutic strategies against different neurodegenerative disorders, ALS and FTLT; (3) Specific materials for drug delivery; (4) Total synthesis of natural products for drug development in diabetes and neurodegenerative disease.

- **Understanding of disease mechanisms**

The role of membrane proteome, phosphoproteome, and nitrosylproteome associated with disease; (2) Mechanistic study and development of inhibitors for HIV-1 and influenza infections; (3) Study of interactions between glycoconjugates and envelop proteins of viruses; (4) Elucidation of NO sensing for redox regulation by transcriptional factors in *E. coli*.

- **Study in cell structure and function**

Investigate the structure and function of RNA polymerases and DNA repair enzymes; (2) Study protein folding and bioenergetics; (3) Elucidate protein self-assembly formation and structural/functional relationship between vaccinia viral proteins and glycosaminoglycan; (4) Establish artificial enzymes (metalloproteins) with the catalytic power; (5) Tune the prominent regio- and stereo-selective hydroxylation of cytochrome P450 BM-3 variants.

- **Development of biosensors**

Synthesis of many types of fluorescent biosensors and development of new calibration methods and fluorescence-reporting biosensors; (2) Surface functionalized nanoprobe-based affinity mass spectrometry for multiplexed quantitation of disease-associated protein markers.

Sustainable Catalyst & Synthesis:

- **Green technology of organic synthesis**

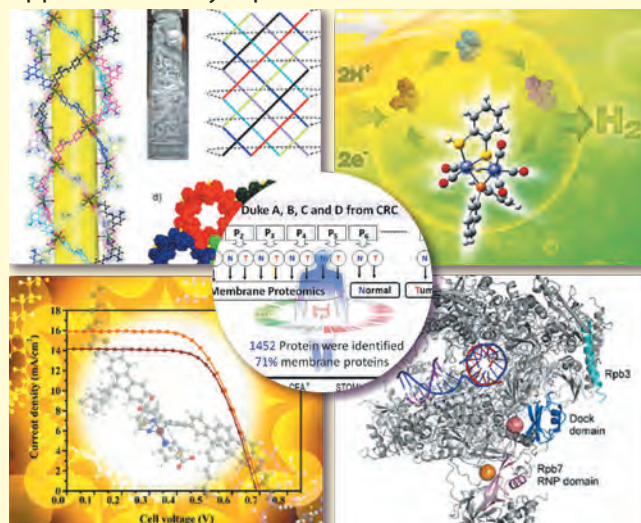
We aim to develop green synthetic technology for the synthesis of nature products, therapeutic drugs, and chemicals for material science. The development of highly efficient and enantioselective catalysts for organic synthesis will be our focus. Homogeneous and heterogeneous catalysts which can catalyze C-C, C-N, C-O, or C-S bond formation will be studied. Synthetic methodology using environmental-friendly solvents as well as reagents, such as water, supercritical fluid, or ionic liquid, and the adopting of new microfluidic technology in synthesis will be explored.

- **Energy related catalysis**

In specific, development of catalysts for water splitting, CO₂ activation, and hydrogen generation will be directed along with other small molecular activations. The catalysts will be incorporated into a sustainable energy driven fuel device. The C-H bond activation and oxygenation catalysts which can convert methane or hydrocarbons to alcohols will be advanced for the production of liquid fuel or incorporation with fuel cells. Biomass technology using native or mutated enzymes for the generation of renewable fuels will also be the major themes.

- **Technology for environmental monitoring and therapy**

The sensing probes to detect heavy metals and a variety of toxins will be developed which will be further converted into prototype devices to quantify environmental toxins. Nano-technology and nanoporous materials will be introduced to trap and encapsulate inorganic toxins for environmental remedies. Bacterial and enzyme-based degradation of organic toxins will be studied from fundamental and applied chemistry aspects.



Scheduled Courses

Students with a M.S. degree

- A total of 20 credit units are required for graduation.

Students with a B.S. degree

- A total of 32 credit units are required for graduation.

- At least 12 credit units from Elective Courses

Required Courses:

Courses to be taken by all students

- Introduction to Sustainable Chemical Science and Technology
- Seminar
- Lab Rotation
- Colloquium
- Elementary Chinese

Elective Courses:

Core Courses: Select at least one course

- Advanced Organic Chemistry I
- Advanced Analytical Chemistry I
- Advanced Physical Chemistry I
- Advanced Inorganic Chemistry I

Non-core Courses:

- Advanced Physical Chemistry II
- Advanced Physical Chemistry III
- Advanced Chemical Biology I
- Advanced Chemical Biology II
- Advanced Chemical Kinetics
- Advanced Chemical Thermodynamics
- Advanced Chemistry of Materials
- Advanced Group Theory
- Atmospheric Chemistry and Climate Changes
- Basic Scientific Writing and Presentation in English
- Biochemical Analysis
- Chemical Thermodynamics
- Computational Quantum Chemistry
- Experimental Molecular Biophysics
- Introduction to Molecular Imaging and Analysis
- Laser Bio/Nano Science
- Linear Algebra for Scientist
- Mass Spectrometry
- Modern Experimental Techniques – Chemistry
- Molecular Spectroscopy
- Organometallic Chemistry
- Quantum Chemistry
- Research Techniques in Physical Chemistry
- Special Topic - Into Supramolecular Photo Science

Faculty Members

[Institute of Chemistry, Academia Sinica](#)

Chang, Wei-Hau

Single Molecule Biophysics, Single Particle Cryo-Electron Microscopy, Chemical Biology for Bio-Conjugation

Chen, Chin-Ti

Materials Chemistry

Chen, Yu-Ju

Proteomics and Mass Spectrometry

Chen, Rong-Jie

Asymmetric Organocatalysis and Natural Products Synthesis

Chiang, Ming-Hsi

Bioinorganic Chemistry and Catalysis

Hsu, Chao-Ping

Theoretical Chemistry

Huang, Joseph Jen-Tse

Biophysical Chemistry and Chemical Biology

Hung, Chen-Hsiung

Porphyrin Chemistry and Bioinorganic Chemistry

Kuo, Chun-Hong

Nanoporous Materials & Nanocrystals

Li, Wen-Shan

Medicinal and Bioorganic Chemistry

Lee, Hsien-Ming

Chemical Biology and Bioorganic Chemistry

Lin, Chih-Hsiu

Organic Material Chemistry

Lin, Jiann-T'suen

Organometallic Chemistry and Material Chemistry

Lu, Kuang-Lieh

Supramolecular Chemistry and Nanomaterials

Luo, Fen-Tair

Advanced Materials, Biomass Supertorrefaction and Supergasification, Catalysis, Metallo-Organic Chemistry

Ong, Tiow-Gan

Organometallic Chemistry with Catalysis Implication in C-H Bond Activation and Organic Synthesis

Shyu, Shin-Guang

Organometallic Chemistry, Materials Chemistry

Sun, Shih-Sheng

Supramolecular Materials Chemistry

Tao, Yu-Tai

Materials Chemistry and Surface Chemistry

Tzou, Der-Lii M.

NMR Spectroscopy and Biophysical Chemistry

Wang, Cheng-Chung

Carbohydrate Chemistry, Automated Synthesis of Glycoconjugates and Glycobiology

Yu, Hsiao-hua

Organic and Polymer Materials, Nanobiotechnology, Cell Materials Interface

Yu, Steve Sheng-Fa

Bioorganic Chemistry and Bioinorganic Chemistry

[Sustainable Chemical Science and Technology Program.](#)

[National Chiao Tung University](#)

Chen, Jiun-Tai

Polymer Chemistry, Polymer Nanomaterials, Optoelectronic Polymers, Thin Film Fabrication

Chen, Yu-Chie

Biological Mass Spectrometry and Nano Biotechnology

Chung, Wen-Sheng

Physical Organic Chemistry, Host-Guest Chemistry, Organic Photochemistry

Diau, Eric

Femtochemistry, Nanochemistry, Spectroscopy and Photochemistry

Hsieh, You-Zung

Analytical Chemistry, Microchip Capillary Electrophoresis

Lee, Yuan-Pern

Physical Chemistry, Laser Chemistry, Spectroscopy

Mong, Tony

Organic Synthesis, Carbohydrate Chemistry, Synthesis and Design of Biomacromolecule

Shigeto, Shinsuke

Molecular Imaging, Molecular Spectroscopy, Biophysical Chemistry, Laser Chemistry

Sun, Chung-Ming

Combinatorial Drug Discovery, Microwave-Assisted Polymer Supported Synthesis, Chemicalgenetics

Wang, Chien-Lung

Polymer Physics, Conjugated Molecules, Self-assemble Functional Materials, Supramolecular Chemistry

Witek, Henryk

Quantum and Computational Chemistry, Applied Linear Algebra, Perturbation Theory

Urban, Pawel

Analytical Chemistry, Microscale Biochemical Analysis, Forensic Chemistry, Mass Spectrometry, Separation Science

Institute of Earth Sciences, Academia Sinica

Wang, Chung-Ho

Global Warming and Environmental Changes in Taiwan, Isotope Hydrology and Hydrological Changes in Taiwan, Isotope Geochemistry

Research Center for Environmental Changes, Academia Sinica

Chou, Charles C.-K.

Aerosol Physics and Chemistry, Air Quality Monitoring, Urban Air Pollution Control

Ho, Tung-Yuan

Marine Biogeochemistry, Marine Organic Chemistry, Environmental Analytical Chemistry

Agricultural Biotechnology Research Center, Academia Sinica

Shih, Ming-Che

Integrative Plant Stress Biology, Enzyme Biotechnology

Institute of Biological Chemistry, Academia Sinica

Liang, Po-Huang

Enzymology, Drug Discovery, Chemical Biology

Lin, Chun-Hung

Drug Discovery, Chemical Biology, Carbohydrate Synthesis and Glycobiology

Requirements for the Ph.D. Degree

(1) Course Work

All courses will be offered in English. Basically, during the first two years. Students are also required to take a one-credit course on Seminar and Colloquium during each semester of the first academic years. In addition, it is the responsibility of the advisor to assist each student in formulating a program of study that will best satisfy his or her personal needs as well as fulfilling the graduate requirements.

(2) Selection of Research Advisor

At least 2 laboratories have to be selected for lab rotation within the first academic year. Each lab rotation period shall not exceed three months and must be carried out under the supervision of different professors. Consultation from the Academic and Student Affairs Committee will be provided to students who have difficulty finishing 2 lab rotations or identifying a thesis advisor. By September 1st of the second academic year, students must have identified your thesis advisor.

(3) Qualifying Written Examination

There are three written examinations of each academic year in November, March, and July. Student can choose one subject approved by the Advisor. Students must pass the written exam three times within three academic years. A passing grade is 70 out of 100.

(4) Qualifying Oral Examination

PhD student must have a research plan approved by his/her advisor before the end of third academic year. A passing grade is 70 out of 100. If student does not pass, he/she must retake his/her oral exam 3 within one year up to one time.

(5) Advancement to Candidacy

The criteria for advancement to candidacy include: (1) completing course work and meeting the minimum credit requirement; (2) passing the qualifying

examinations (both written and oral examinations). Once a student has been advanced to candidacy, he or she will begin to devote full time to independent study and research on his or her thesis topic.

(6) Thesis Defense

A Ph.D. candidate defends his or her thesis research before a thesis committee. This defense will take the form of a thesis seminar followed by an oral examination on the research. The examination committee shall consist of faculty members familiar with the candidate's area of research. Some of the thesis examining committee must come from another institution.

Application to SCST Program

The Program offers admissions to the fall semester only. Application can be submitted through the on-line application system: <http://db1x.sinica.edu.tw/tigp/>, or by post to:

Admissions Office, Taiwan International Graduate Program, Academia Sinica
No. 128, Sec.2, Academia Road, Nankang, Taipei
11529, Taiwan

We strongly suggest online application.

The submitted application materials will not be returned to applicants under any circumstances. The complete application materials should be received by TIGP before March 31.

The following criteria will be the basis on which an application's qualification for admission is evaluated:

(1) Formal undergraduate and graduate academic records or transcripts

(2) Graduate Record Examination (GRE) scores in General Test

GRE is highly recommended. However, an applicant who fails to meet this requirement may submit additional criteria for committee evaluation. The GRE Subject Test is optional and one of the following subjects: Chemistry, Physics, Mathematics, or Biology is strongly recommended.

GRE substitution: If under special circumstances the test is not taken, some proof of applicant's competency might be considered. This proof should be more than just recommendation letters and transcripts, for example, documents like the award records, exam scores of national or international level, scientific publications, etc. will be helpful.

The admission committee will decide whether the proof is strong enough to support the application.

(3) English proficiency

Applicants whose first or native language is not English are required to submit one of following English proficiency test report (the listed scores are strongly recommended):

TOEFL		IELTS	GEPT
Internet-based TOEFL(TOEFL-iBT)	79	5.5	High Intermediate Level
Computer-Based TOEFL	213		
Paper-Based TOEFL	550		

Applicants who have completed a degree program in an English speaking country, or who graduated from university where English is the primary language of instruction, maybe be exempted from the test of

English proficiency with an official certification issued by the Office of Registrar.

(4) Three letters of recommendation

Each letter comments on the applicant's personal character, and qualifications for independent study, including intellectual ability, research potential, and scientific motivation. One of the letters should be provided by the applicant's advisor.

(5) The admission for Students with a B.S. degree

First, students should have five or more years of work experience related to their undergraduate study. Second, any publication of which content is comparable with the thesis of M.S. should be included in the application package. Otherwise, a written report of achievement from previous working job(s) is necessary.

(6) Statement of purpose (plan for graduate study) in English

Specifically, we would like to see following items/questions being addressed.

- What area/topics do you want to study and research?
- Why do you want to study and research in this area/topics?
- How can SCST program help you pursue this research area/topics?

Cost of Study

The payment of tuition fees (basic fee + credits fee, about NT\$ 55,000/USD 1,700 per semester) for international students should be made on Student Registration Day. Partial subsidies for the tuition fees will later be provided (by Academia Sinica) to all international students.

Fellowship Support and Stipends

Fellowship will be granted for applicants who receive admission. The stipend levels are about NT\$34,000/month (~USD1133/month) for the first year. Additionally, the support will be extended to two more years for those students who perform well academically. In subsequent years, the financial support will be provided by the student's thesis advisor with his/her research grant. The amount of the support will be under the discretion of the advisor.

Medical Insurance

For international students only. Six months after the student receives the Alien Resident Certificate (ARC), the student will be qualified for Taiwan's National Health Insurance Program. The students are expected to pay the same premium as all the Taiwan citizens and will be entitled to the same medical coverage.

Living and Housing Costs

Options include on-campus housing and off-campus housing. On-campus self-catering student dormitory providing single study bedrooms is available to TIGP students at reasonable costs (for details, please visit our website at <http://tigp.sinica.edu.tw/housing.html>). Off-campus private housing is generally more expensive. Rents for off-campus apartments range from NT\$5,000–15,000 per month.

Correspondence and Information

For general information of TIGP

TIGP website: <http://tigp.sinica.edu.tw/>

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TIGP, Academia Sinica
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Nankang, Taipei 11529, Taiwan
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For general information of SCST program

SCST website: <http://tigp-scst.chem.sinica.edu.tw>

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