



Nano Science and Technology Program (NANO)

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.

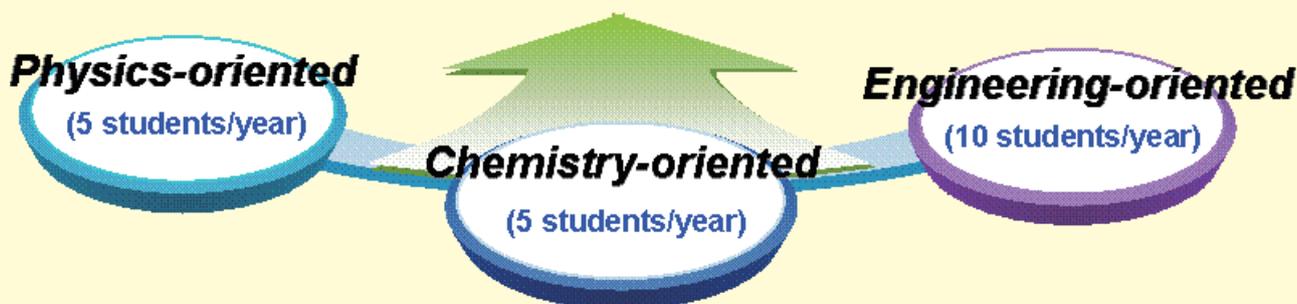
TIGP will offer Ph.D. programs in only selected disciplines to be agreed upon between Academia Sinica and these research universities. It is the intent of the Program to offer Ph.D. education programs only in inter-disciplinary areas in the physical sciences, applied sciences, engineering, biological 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 "Nano Science and Technology"

Within this context, the graduate program on "Nano Science and Technology" is designed to offer specific training and research opportunities to Ph.D. students who are interested in the following areas: characterization of nanomaterials and nanostructures, new nanomaterials and structures, theoretical modeling, nanodevices engineering and nanobiotechnology. This option is a collaborative effort among the Academia Sinica, National Taiwan University and National Tsing Hua University. In accordance with these research areas, the Nano Science and Technology program is divided into three categories, namely, "Physics-oriented", "Chemistry-oriented" and "Engineering-oriented" sub-programs. The number of total students admitted to "Nano Science and Technology" Program every year is limited to twenty. The drawing below shows the number of students that can be recruited in each sub-program. The bulk of these students are international students with reasonable proficiency in the use of the English language. However, highly qualified Taiwan students (up to 10 people) with adequate English proficiency are also considered. These students may ultimately elect to do their thesis research with affiliated faculty whose principal appointments are associated with the participating research universities.

Nano Science and Technology Program



Three sub-programs and targeted number of students in a year in each sub-program

A whole array of laboratory equipment and facility for teaching and research are available within the participating units. The following is a list of some examples -- device fabrication facilities: electron beam lithography, reactive ion etching machines, ion milling machine, nanoparticle spray system. Inspection and characterization instruments: scanning electron microscope, scanning tunneling microscope, high resolution transmission electron microscope, atomic force microscope, magnetic force microscope, near-field scanning optical microscope, micro-Raman/ photoluminescence microscope, ESCA/XPS/Auger spectroscopy, ultra-fast laser spectroscopy, and measurement facilities such as automatic surface plasma resonance-based biosensor, microwave instruments.

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 interest, 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 Physics (<http://www.phys.sinica.edu.tw/>)

Institute of Atomic and Molecular Sciences

(<http://www.iams.sinica.edu.tw/>)

Research Center for Applied Sciences

(<http://www.rcas.sinica.edu.tw/>)

National Taiwan University

Department of Chemistry

(<http://www.ch.ntu.edu.tw/>)

Department of Physics (<http://www.phys.ntu.edu.tw/>)

Center for Condensed Matter Sciences

(<http://www.ntu-ccms.ntu.edu.tw/>)

National Tsing Hua University

Department of Engineering and System Science

(<http://www.ess.nthu.edu.tw/>)

Research Topics

• **Synthesis of nano structures composed of various materials**

Synthesis of nanostructures such as quantum dots, nanotubes and nanowires, quantum wells, porous materials, nanocomposites, magnetic materials, surface nanostructures, and conducting molecules lays the foundation of nanotechnology. Rational designs of these materials by means of chemical synthesis and fabrication technique such as physical vapor deposition, chemical vapor deposition, molecular beam epitaxy, pyrolysis method, anodic oxidation, solvothermal method, sol-gel method, and self-assembly method are employed to produce nanomaterials of specific composition, size, structure, shape, and functionality.

• **Characterization of nanostructures**

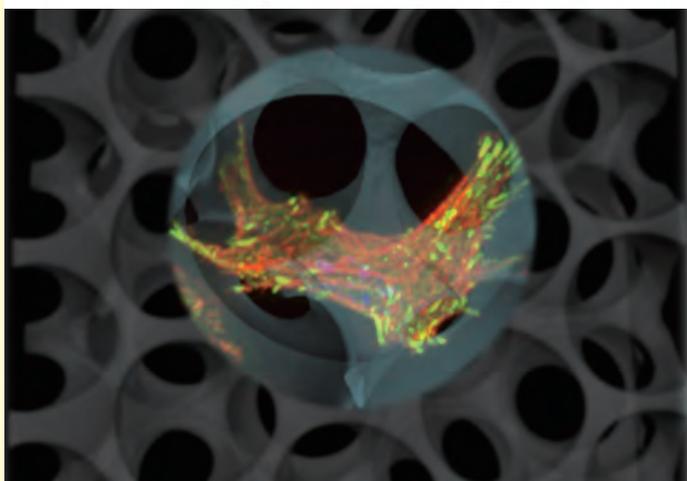
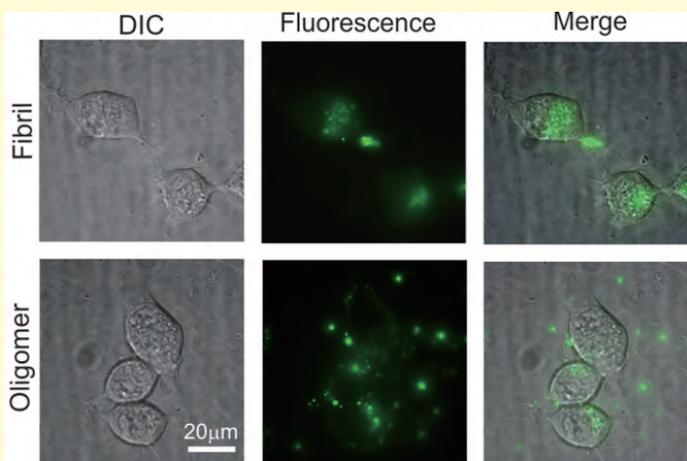
Studies of thermal, optical, electronic, magnetic properties and surface structure of the synthesized nanostructures give a feedback to the synthesis process. Major characterization techniques include scanning probe microscopy, electron microscopy, calorimetry, linear and non-linear optics, X-ray photoelectron spectroscopy, Auger electron spectroscopy, Raman spectroscopy, photo- and cathode-luminescence, etc. In addition, electrical transport measurement, spin-dependent transport under high-field and low-temperature, as well as field emission from tips made of various materials are carried out.

• **Theoretical modeling**

Theoretical studies of electrical and thermal conduction properties and non-linear optical properties provide our fundamental understanding about the synthesized nanostructures and may serve as a guide for the future directions. Chemical properties such as catalytical activities, formation mechanism, chemical reactions and other rate processes are also investigated. The theoretical methods employed include ab initio and molecular dynamics calculations, path-integral method, and density functional theories.

• **Exploration of nanodevices**

Fabrication and characterization of a variety of nanodevices and electric components associated with photonics, optoelectronics, molecular electronics, spintronics, superconducting devices, micro- and nano-mechanics, biochips pave the way for future applications. Various techniques for monolithic and hybrid integrations of the components into device modules and subsystems are explored.



• **Nano-biotechnology**

Advanced bioimaging techniques using nanobeam X-rays, phase-contrast transmission electron microscopy, super-high resolution fluorescence and non-fluorescence based optical imaging, scanning probe microscopy are employed to study behaviors of cells and biomolecule. We also explore potential applications of colloidal, fluidic, plasmonic, and polymeric nanostructures for biosensing.

Scheduled Courses

Required Courses:

- Introduction to Nanotechnology
- Advanced Nanotechnology
- Seminar: four semesters

Elective Courses:

- Quantum Mechanics
- Statistical Physics
- Classical Electrodynamics
- Solid-state Physics
- Computational Materials Science
- Advanced Organic Chemistry
- Advanced Inorganic Chemistry
- Advanced Physical Chemistry
- Advanced Analytical Chemistry
- Advanced Chemistry of Materials
- Organometallic Chemistry
- Introduction to Nano-biophotonics
- Fabrication and Analysis of Nanostructures
- Characterization, Fabrication, and Manipulation at Nanometer Scale

Teaching Assistant and Chinese Language

Teaching assistant experience is an essential part of our program. Thus, all students from TIGP must serve as a teaching assistant for at least one semester. Also, in order to help the international students in their daily live communication with the local people, we offer a required one-year course in Mandarin Chinese.

Academic System

The program emphasizes research training and developing one's self-reliance and self-confidence for independent work. In the Nano Science and Technology Program, faculty members will take turns to serve as mentors for newcomers until the students have chosen their thesis advisors. The program adopts a team-teaching system in which each faculty member teaches the subject according to his or her expertise. Courses offered include some traditional core courses, elective courses, and special topics, as listed in the Scheduled Courses section. In keeping up with the international stature of the program, all courses will be offered in English.

Requirements for the Ph.D. Degree

(1) Course Work

Basically, during the first one-and-a-half or two years, students are advised to complete all courses as required by each Department. Students are also required to take a one-credit course on "Seminar" during each semester of the first two 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

Students are expected to identify a thesis advisor by the end of the first six months, but, in any case, no later than the first year of graduate study. Every incoming student is expected to become familiar with the research work of a number of laboratories before signing up for a specific faculty member. The process might involve attending a series of seminars on faculty research in the program, or a series of laboratory rotations. Although every effort will be made to honor the student's first or second choice of thesis advisor, the Graduate Study Committee of the program, taking into account of numerous factors, must approve the final selection of thesis advisor.

(3) Qualifying Written Examination

A student seeking admission to the Ph.D. candidacy must take the qualifying examinations according to the regulations of qualification examination of each Department. Students who fail to meet the requirement will be disqualified for staying in the Program.

(4) Qualifying Oral Examination

The oral examination, which is held after students pass their qualifying written examination, is based predominantly on a research proposition submitted by the student. However, before presenting the proposal to the examining committee, the student should be prepared to discuss with the committee members his or her research progress and plans for the thesis work, including relevant literature. Students who fail to meet the requirement will be disqualified for staying in the Program.

(5) Advancement to Candidacy

The criteria for advancement to candidacy include: (1) completing coursework and meeting the minimum credit requirement; (2) passing the qualifying examinations (both written and oral examinations) required by Department. 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.

Admission to the Ph.D. Program

The Program admits students to the fall semester only. Application materials are available in the TIGP web site. The application deadline is on March 31 each year.

Students (either international students or students from Taiwan) with a M.S. degree from an accredited institution may be admitted to the chemistry-oriented and physics-oriented sub-programs. Those with a B.S. or M.S. degree may be admitted to the engineering-oriented sub-program. Selection of program should be made at application. The following criteria are used to evaluate the applicant's qualifications for admission:

(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.

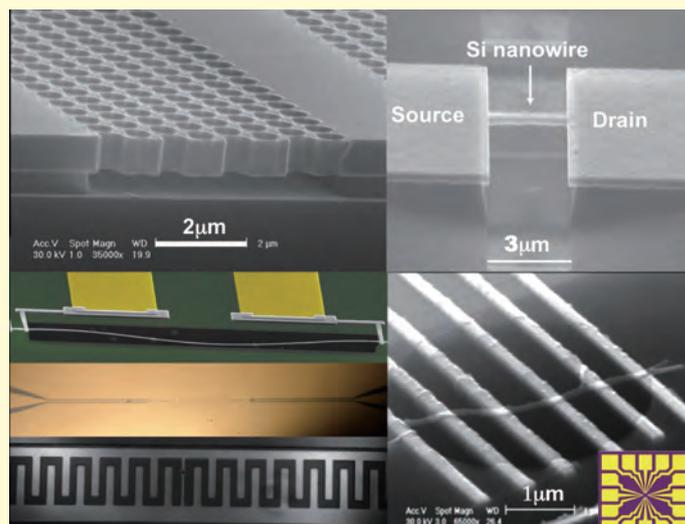
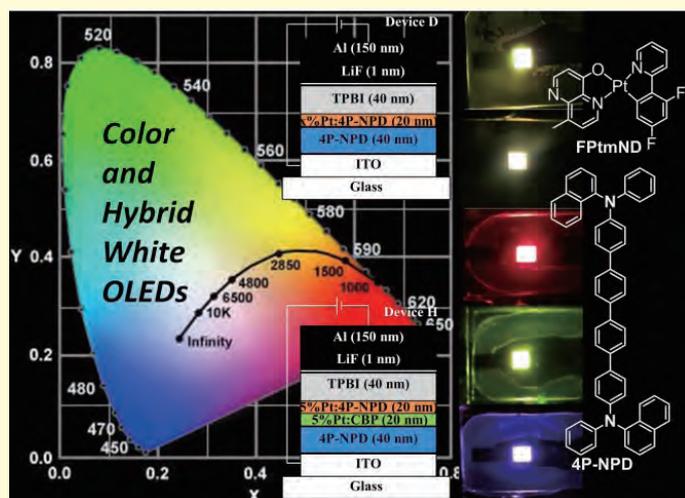
The admission committee will decide whether the proof is strong enough to support the application.

(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:** scores 550 on the paper-based (or 213 on the computer-based or 79 on the New Internet-based TOEFL (TOEFL-iBT)) or higher (Our institution CODE & NAME are: 7142 Academia Sinica). Please note that institutional TOEFL will not be accepted; only ETS International TOEFL will be accepted
- GEPT:** applicants in Taiwan may take the General English Proficiency Test (GEPT) administered by the Language Training and Testing Center. Applicants are required to submit their High-intermediate level certificate when applying for admission.
- IELTS** (International English Language Test System): score 5.5 or higher is required.

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

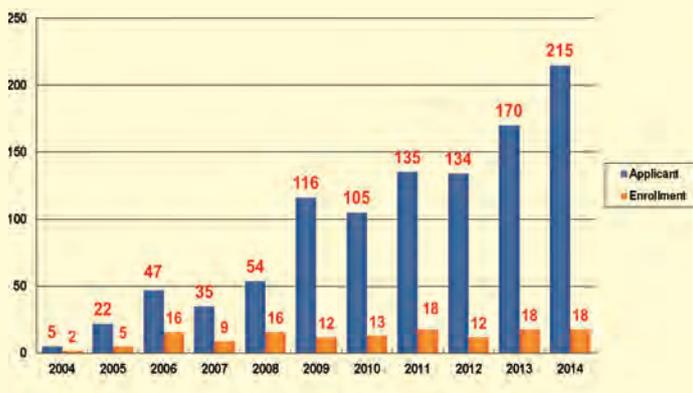
Application can be submitted through the on-line application system (recommended)

<http://db1x.sinica.edu.tw/tigp/index.php> or by post to: Admissions Office

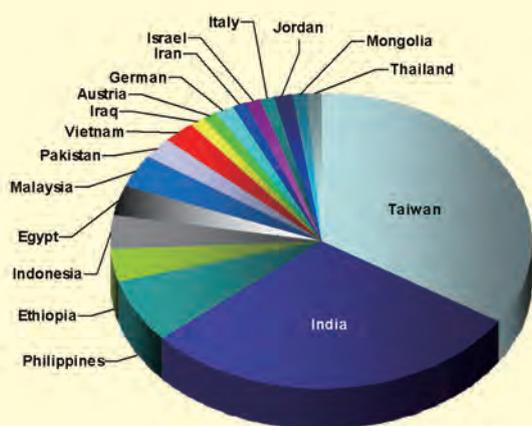
Taiwan International Graduate Program
No. 128, Sec.2, Academia Road,
Nankang, Taipei 11529
Taiwan

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 Nano Science and Technology Program was launched in 2004. The bar plot below depicts the enrollment rates in years 2004-2014.



The pie plot below shows the distribution of nationalities of the current students.



Distribution of Students' Nationalities in Nano Science and Technology Program

Student Status and Degree Conferral Policy

Based on the Regulations of the Ministry of Education in Taiwan, students will officially register with our partner universities, National Taiwan University and National Tsing Hua University, depending on the particular program. Upon completion of our program, each student will be conferred a Ph.D. degree by the partner university and a certificate jointly signed by the President of Academia Sinica and the Director of TIGP.

Cost of Study

The payment of tuition fees (basic fee + credits fee, about NT\$58,000/US\$1,800 per semester) for international students should be made before 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 (about USD\$1,130/month) for the first year. Additionally, the support will be extended to two more years for those students who perform well academically. The academic performance of each student will be reviewed by the Academic Committee every year. The Committee may decide to reduce the students' stipend level if his or her performance is less satisfactory. 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 at 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 (NHI). 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.

Meals are available on campus at the Activity Center Cafeteria, the Cafe, the Chinese Restaurant, and the Western Restaurant at modest costs. Various types of local cuisines are also available at off-campus cafeterias and restaurants within walking distance and at affordable costs.

Correspondence and Information

For general information concerning TIGP, please contact:

Ms. Huan-Yi Shen

TIGP administrative assistant
Taiwan International Graduate Program
Nankang, Taipei 115, Taiwan
E-mail: tigp@gate.sinica.edu.tw
Tel: 886-2-2789-8050
Fax: 886-2-2785-8944
TIGP website: <http://tigp.sinica.edu.tw/>

For information concerning this program, please contact:

Dr. Chii-Dong Chen

Institute of Physics, Academia Sinica
Tel.: 886-2-2789-6766
E-mail: chiidong@phys.sinica.edu.tw

Ms. Liang-Hui Wu

Administrative Assistant
Nano Science and Technology Program, TIGP, Academia Sinica
Tel.: 886-2-2789-8794
Fax: 886-2-2789-8794
E-mail: lhwu@phys.sinica.edu.tw
Program website: <http://www.phys.sinica.edu.tw/TIGP-NANO/>

This program is sponsored by

Institute of Chemistry
Institute of Physics
Institute of Atomic and Molecular Sciences
Research Center for Applied Sciences
Academia Sinica

in cooperation with

Department of Chemistry
Department of Physics
Center for Condensed Matter Sciences
National Taiwan University

Department of Engineering and System Science
National Tsing Hua University

