
Physics Education and Research at Royal University of Phnom Penh

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BACKGROUND AND HISTORY

The Royal University of Phnom Penh (RUPP)'s Department of Physics was established along with the establishment of the university's Faculty of Science and Technology in 1960¹. From 1975 to 1980, Physics classes ceased, as did all other forms of higher education in Cambodia. From 1980 to 1989, the Department of Physics was reopened as part of a teacher training college, a training of trainers to become teachers of Physics in Cambodian high schools. In 1990, a new B. Sc. in Physics Program was developed as the only program in Cambodia, whose curriculum focused on General Physics, Applied Physics and Basic Research for undergraduate level. Until recently, RUPP's Department of Physics has remained the leading department of Physics in Cambodia offering Physics education and research for higher education. Importantly, lecturer capacity development to get a PhD abroad as part of the internal capacity development policy, recruitment of new qualified academic staffs, international collaboration, curriculum development, and number of students participating in the Department of Physics have been of our focus. It should be noted that in 2008, RUPP established its M. Sc. in Physics Program. From the establishment till October 2017, the master program was under the Faculty of Science. However, from October 2017, RUPP has established the Graduate School of Science (GSS) to strengthen the quality of postgraduate education, including M. Sc. in Physics, M. Sc. in Chemistry, M. Sc. in Biodiversity Conservation, M. Sc. in Mathematics, and Master of Information Technology Engineering Programs, as well as to promote scientific research culture at RUPP. Eventually, all of the graduate programs of science are currently under the GSS of RUPP.

POSTGRADUATE PROGRAMS

Under the direct financial and technical supports from the Royal Government of Cambodia and foreign development partners from Sweden, Korea, Japan and Germany, the Department of Physics has significantly grown and continues to grow in terms of new establishment of educational program and research laboratories. This makes the Royal University of Phnom Penh's Department of Physics the best choice of about 300 current undergraduate and 20 graduate students in Physics in the 2017-2018 academic intake. On one hand, the Royal University of Phnom Penh's GSS has strengthened its M. Sc. in Physics program by offering more interesting Physics courses and practical Physics experiments and research opportunities than ever, which are useful for students' knowledge, skills and research developments, on the other hand it has prepared itself to offer a postgraduate program and post-doctoral research fellowship in Physics by establishing new research laboratories, recruiting qualified academic and research staffs, and improving international collaborations. This aims at attracting not only Cambodian students but also regional and international students to join the program to study a variety of knowledge and conduct several researches in the fields of nanomaterials and applications to sensors, condensed matter physics with the focus on two-dimensional material growths and characterizations, energy harvesting, environment and health, applied optics and photonics, and theoretical and computational physics. It also aims at attracting scientific collaborations with

¹Source of information: Royal University of Phnom Penh's History found at <http://www.rupp.edu.kh>.

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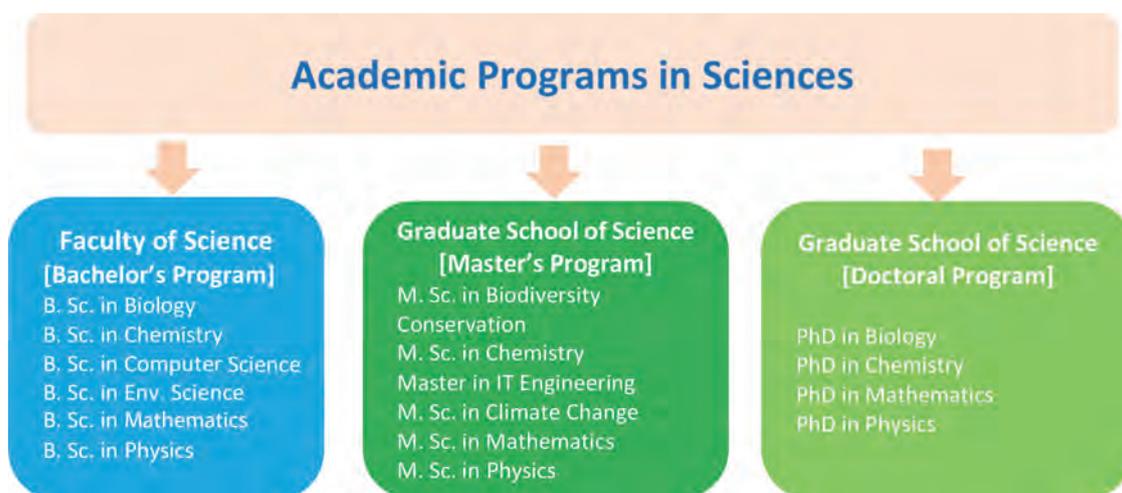


Fig. 1: The structure of academic program in sciences at RUPP.

foreign partners in the fields of expertise of its qualified academic and research staffs. Upon the establishment of new research laboratories, five different research groups have been formed such as Nanomaterials and Applications, Renewable Energy, Photonics and Applications, Theoretical and Computational Physics, and Condensed Matter and Thermal analyzer. The followings are brief descriptions about the current focus of these groups and key academic staffs who have been involved or will get involved shortly after their PhD in the research groups. The current structure of academic programs in sciences at RUPP is shown in the figure below. Currently, GSS possesses six graduate programs, including M. Sc. in Biodiversity Conservation, M. Sc. in Chemistry, Master in IT Engineering, M. Sc. in Climate Change and M. Sc. in Mathematics. As planned, GSS aims to establish its Doctoral Programs by 2020.

RESEARCH AREAS

A. Nanomaterials and Applications

Upon finishing his PhD in Physical Electronics and Nanotechnology from the Department of Science and Technology, Linköping University, Sweden, Dr. Chan Oeurn Chey, during his post-graduate study under the supervision of Prof. Dr. Magnus Willander, authored and co-authored more than 20 peer-reviewed articles, with his colleague who also graduated from the same program with similar qualification, established the Laboratory of Applied Nanomaterials, in August 2015. The establishment was mainly supported by the Royal Government of Cambodia and the International Science Programme (ISP), Uppsala University, Sweden and partially sup-

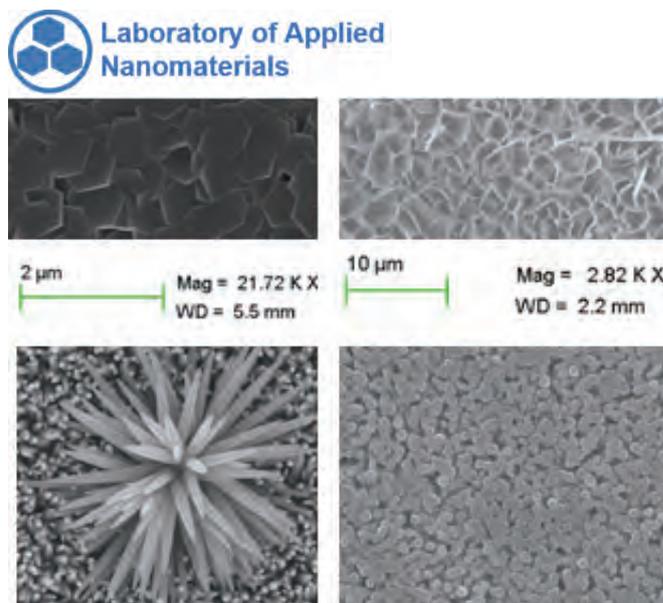


Fig. 2: SEM images of Metal Oxides Nanostructures.

ported by other foreign partners. As time goes on, the laboratory grows to include more members from the Department of Physics and its research focus is on the growth and characterizations of electronic, magnetic and photonic metal oxides semiconductor nanomaterials as well as two-dimensional materials. Recent studies include novel spintronic nanomaterials, wide bandgap semiconductors nanostructures. The group also looks at the applications of the nanomaterials in sensors, environment, food, health and energy harvesting technology, including solar cell technology, piezoelectric and thermoelectric technology. *The leader of the Nanomaterials and Applications group is Dr. Chan Oeurn Chey.*



Fig. 3: Lab visit by Minister of Education, Youth and Sport.

B. Condensed matter and thermal analyzer

On the process of preparation of its structure and facilities, the laboratory of Condensed Matter and Thermal Analyzer is expected an establishment and research activities in 2019, under the technical support of emeritus professor in Physics, Prof. Tozaki Ken-ichi of Chiba University, Japan. Condense matter is particularly important because it helps us truly connect Quantum Mechanics with the scale of Physics on which the experiment can be performed. It includes all the substances that can be found on earth and that are important to our everyday experiences and to technology. Main research activities in this laboratory are subjected to study and analyze the phase transitions (glass transition, crystallization and melting) of condensed matter by using high-resolution thermal analyzer (TA). This TA is utilized to vary the temperature at very slow scanning rate (up to $50 \mu\text{K/s}$). A novel technique leading to the discovery of the solid-solid transition in glycerol (K. Sou et al., High-resolution calorimetry on thermal behavior of glycerol (*I*), *Chemical Physics Letters* 506(4),217-220, 2011). *The leader of Condensed Mater and Thermal Analyzer group is Dr. Kalyan Sou.*

C. Renewable Energy

Renewable energy can lead to poverty reduction, economic growth, and environmental sustainability. In other words, the renewable energy solutions can yield important social, economic and environmental benefits and it can contribute to reducing greenhouse gas emissions and energy efficiency. Therefore, providing sustainable, reliable and affordable energy solutions to people, communities and countries can significantly improve their living standards and economic status. The Renewable Energy Research group focuses on renewable energy sources, energy efficiency and application of renewable energy

technology for sustainable community development for better future. We develop innovative solutions and tools within the areas of energy in building and environment. We analyze the energy system with the aim of developing sustainable energy systems. Research is conducted within three main areas: local energy sources, energy technology for agriculture, and building energy systems. *The leader of the Renewable Energy group is Dr. Chan Oeurn Chey.*

D. Theoretical and Computational Physics

In theoretical and computational physics, we undertake research in the area of semi-classical methods in quantum physics with particular emphasis on the quantum to classical transition. The basic formulation of time-dependent and time-independent scattering theory and its application in atomic physics is also studied currently in this group. In this research area we concentrate on the theory of the interaction of strong short laser pulses with matter. The time scales vary from atto-seconds to femto-seconds and concern the fragmentation of atoms and molecules and the production of photo-electrons. This involves practical application of theoretical developments of the Theoretical Physics group. *The leader of the Theoretical and Computational Physics group is Prof. Dr. John Briggs.*

E. Photonics and Applications

Dr. Seang Hor Eng who has earned his M. Sc. and PhD in Physics from Sogang University, Korea, and who has been a post-doc research fellow in the field of photonics and applications at Photonics lab. of Sogang University, is invited to join RUPP. He authored and co-authored several peer-reviewed articles and patents during his study and fellowship at Sogang University. Photonics and applications research laboratory will be established shortly upon his arrival at RUPP. The laboratory's focus is on developing high sensitivities, speed, resolution and compact optical sensors for various applications. More precisely, the research activity is focused on several applications of interferometry, mainly on super resolution optical scanning microscope, high sensitivity biochip readout sensors, fluidic channel readout sensors, multi wavelength interferometer for biosensor applications, and developing interferometer for high resolution full-field optical coherence microscopy for biomedical imaging applications. The mission is to produce high-quality scientific knowledge, expert in selecting, testing and integrating optical components, and practical skill in experiment in the field of photonics and applications through the research activities. *The leader of Photonics and Applications group is Dr. Seang Hor Eang.*

LIST OF KEY RESEARCHERS

Chan Oeurn Chey, PhD

Synthesis, characterization of nanomaterials and their applications in environment, food, health and energy. *Leader @ Nanomaterials and Its Applications and Renewable Energy.*

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Prof. John Briggs, PhD

Fundamental Quantum Mechanics and time dependence. Scattering theory of atomic, molecular and photonic collisions. Light-absorption by quantum aggregates. Solar collector and solar concentrator design. *Leader @ Theoretical and Computational Physics.*

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Tharith Sriv (PhD candidate)

Currently focuses on 2D materials (SnS₂, SnSe₂, SnSe-SnS alloys) characterization using Raman spectroscopy, Photoluminescence, AFM. Been also involved in characterization of graphene, MoS₂, WS₂, WSe₂, and CZTS/CZTSe thin films solar cells. *Member @ Nanomaterials and Applications.*

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Kimleang Khun, PhD

Semiconductor, Materials characterization, Thin film and Nanotechnology, and Sensors and Photonics Devices. *Member @ Nanomaterials and Applications.*

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Kalyan Sou, PhD

Phase transition of condensed matter (Glycerol), High-resolution calorimetry at very slow scanning rates (up to 50 μ K/s), Supercooled water confined to exterior and interior of mesoporous MCM-41.

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Seang Hor Eang, PhD

Developing high sensitivities, speed, resolution and compact optical sensors for various applications.

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Sunly Khimphun, PhD

Gauge/Gravity theory, AdS/CMT
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Chandany Sen (PhD candidate)

Semiconducting Materials, a-Si:H and a-SiC:H Thin films, Nanotechnology, and Renewable Energy. *Member @ Renewable Energy.*

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Chan Oeurn Chey graduated his PhD from the Department of Science and Technology, Institute of Technology, Linköping University, Sweden in January 2015. He is Acting Dean of Graduate School of Science at Royal University of Phnom Penh (RUPP). He also works as deputy head of the Strategic and Planning Team of RUPP and he is a member of Education Research Council of the Ministry of Education Youth and Sport. Chan Oeurn works in other tasks at RUPP, as person in charge of research and international relations at the faculty of science, as program coordinator of MSc. in Physics and as teacher trainer and team leader for the Cambodian team for the Asian Physics Olympiad (APhO), International Physics Olympiad (IPhO), Search for SEAMEO Young Scientists (SSYS), APT-JSO and Global Natural History Day (GNHD) competitions. Currently, Chan Oeurn is working as project coordinator of Science program for RUPP-SIDA 2018-2023 Bilateral Program and Research Coordinator at RUPP for Higher Education Improvement Project (HEIP 2018-2023).