Potential Research Titles for Ph.D. Thesis for TAS proposed by

Thailand Institute of Nuclear Technology (TINT)

สถาบันเทคโนโลยีนิวเคลียร์แห่งชาติ (องค์การมหาชน)

Potential Research Titles	เรื่องที่พร้อมรับ น.ศ. 65	นักวิจัย TINT
1. Modification of carbon-based materials from biomass via radiation processing	√	ธนกร ความหมั่น และ ธีรพัชร์ ชุติมาสกุล
The goal of this research is to modify the surface properties of carbon-based materials using radiation processing (electron beam, gamma, plasma, and proton). Furthermore, fabrication and advanced characterization of carbon dots, activated carbon, and biochar from biomass, aided by radiation processing, and applied for electrical electrode application and pollution treatment. We aim to be an innovation hub for high-quality carbon-based materials fabrication via green radiation processing, with a high potential to share our innovation and products with universities and industrial sectors.		Co-advisors from partner labs outside TINT (if any): **RMUTT** **TU**
2. Fabrication of cellulose fiber based functional material by radiation processing for food and environmental applications	√	ฐิติรัตน์ รัตนวงษ์วิบูลย์
Scope: Thailand is an agricultural country which has many natural resources and agricultural products. Among such products, sugar is one of the most important bio-products. Typically, sugarcane bagasse (SB) was a leftover material from sugar production. For every 10 tonnes of sugarcane crushed, about three tonnes of wet bagasse is produced. Radiation technology can be used as a green technology to turn this waste into value-added products. This approach supports to the Bio-Circular-Green (BCG) economy policy and Sustainable Development Goals (SDGs). Furthermore, the value added through this waste upcycling process will provide a very strong socioeconomic impact in Thailand agricultural sector, both in terms of farmers' income and environmental impact from waste. Cellulose is the main component of SB at around 40% composition. From the literature survey, cellulose was reported to exhibit many outstanding properties such as high mechanical properties and high thermal stability. It was therefore utilized as a reinforcing agent in bio-composites. Based on above reasons, the objective of this research is to increase the value of cellulose derived from SB by radiation technology to be used in food and environmental fields. Cellulose based smart packaging and cellulose based adsorbent for removing the pollutants (e.g., dye, heavy metal and toxic gas) will be		Co-advisors from partner labs outside TINT (if any): **Assoc. Dr. Sarute UMMARTYOTIN (TU)**

proposed in this project. Cellulose-based functional materials will be developed using TINT’s facilities such as gamma irradiator and electron beam accelerator. This project requires a student with good chemistry and material science knowledge to achieve the project’s goal.		
3. การใช้รังสีกระตุ้นการสังเคราะห์นาโนไฮบริดขั้นสูงสำเป็นตัวนำส่งอัจฉริยะระดับนาโนเมตรสำหรับการประยุกต์ใช้งานทางด้านชีวการแพทย์ (Radiation-induced synthesis of advanced nanohybrids as smart nanocarriers for biomedicinal applications)	√	ศักดิ์ชัย หลักสี
Scope: Cancer has become the main leading cause and reason for death worldwide. Chemotherapy is one of the most common treatments for cancer. Nevertheless, its treatment is limited by its high toxicity, causing side effects. Then, many studies have combined anticancer drugs with nanocarriers, especially nanohybrids (NHs), to achieve better treatments. This work will present the radiation-induced synthesis of advanced nanohybrids as smart nanocarriers functionalized by new biopolymers for the delivery of anticancer drugs to improve the selectivity, efficacy, and safety of these systems. These systems will be characterized by TEM, EDS, Zetasizer, UV-VIS, XRD, FTIR analyses, etc., and will be tested for *in vitro* or *in vivo* biological activities. To build a new generation of nuclear scientists for the synthesis of novel nanohybrids by radiation processing.		Co-advisors from partner labs outside TINT (if any): **Chulalongkorn University and Silpakorn University**
4. Biopolymer-based nanoparticles for biomedical and cosmetic applications	√	ธีรนันท์ แตงทอง
Scope: Biopolymers derived from natural sources are either chemically synthesized from biological material or entirely biosynthesized by living organisms. Biopolymers have attracted significant research attention due to their biodegradability, biocompatibility and zero toxicity as polymeric materials for biomedical and cosmetic applications, catalyzed by the recent emergence of. nanoscience. Innovative multifunctional nanoparticle-based biomedical and cosmetic applications have integrated medical diagnoses and therapies to achieve more effective treatment methods. Biopolymers and other polysaccharides are now broadly applied in cosmetic formulations. Research in nanoscience and nanotechnology conducted at TINT will improve and broaden study areas of i) Polymer radiation chemistry, ii) Polymer modification, functionalization and characterization, iii) Green nanotechnological design of nanoparticles, and iv) Cellular internalization of		Co-advisors from partner labs outside TINT (if any):

modified nanoparticles. Knowledge and experience gained from these research activities will be used to develop future nanoparticle applications.		
5. Design and Optimization of Heating Scenarios for Thailand Tokamak-2	√	Nopporn Poolyarat
Scope: Energy crisis and climate change are top two concerns for the young generation soon to be faced. Fusion is one of the promising solutions that provide clean and almost unlimited source of energy, hence it is of great interest among science community. Thailand Institute of Nuclear Technology (Public Organization), or TINT, has a plan to develop a second tokamak of Thailand, as a key infrastructure in the second phase, out of three phases of Fusion Technology Development Plan for Thailand. For this Thailand Tokamak-2 (TT-2), the design and optimization of heating scenarios plays important role regarding preparation steps toward developing phase. This research aims to understand heating mechanism and their effects on plasma of Thailand Tokamak-2 under various auxiliary systems and conditions through simulations of integrated codes such BALDUR, CRONOS, etc., as key aspect toward blueprint of the TT-2. This research topic will be in collaboration with 24 domestic institutes under Center of Plasma and Fusion (CPaF) network, and also international institutes such as, Institute of Plasma Physics, Chinese Academy of Science (ASIPP), China, National Institute of Fusion Science (NIFS), Japan.		Co-advisors from partner labs outside TINT (if any): Asst.Prof.Dr. APIWAT WISITSORASAK **(King Mongkut's University of Technology Thonburi)** Asst.Prof.Dr. BOONYARIT CHATTHONG **(Prince of Songkhla University)**
6. Design and Development Superconducting Magnets for Thailand Tokamak 2: Engineering Perspective and Value-Chain Outlook	√	Somsak Dangtip
Scope: Tokamak employs a strong magnetic field to confine the movement of charged particles in plasma, preventing the particles from coming into contact with the reactor walls and holding them while supplying heating. Superconducting magnet is becoming a common practice worldwide to generate strong magnetic field. In Thailand, this advanced high magnetic field is rather limited, not to mention manufacturing to a handsome number for tokamaks. This work includes design and manufacturing a small superconducting magnet field strength of about 3.0 Tesla and to doubling the plasma current in the first tokamak. Students would be able to work closely with partner labs from SLRI, KMUTT, in Thailand, ITER in Europe, Sokendai in Japan. Student(s) shall also be responsible to survey potential of domestic and regional market for manufacturing further number of		Co-advisors from partner labs outside TINT (if any):

magnets, for utilization in other areas and to explore potential for setting up new business for superconducting magnet.		
7. Mechanics and Mechanism for Acceleration and Diagnostics using microwave in Tokamak and Cyclotron	√	Arlee Tamman and Akkapob Ngamlamiad
Scope: Microwave technology play important role in accelerator and fusion technology. This work aims to utilize microwave-plasma interaction to investigate plasma density, temperature, and among other plasma properties. Such analysis would also help following edge localization, transport, and plasma dynamic. The microwave system requires fast signal processing, student will have to make great use of fast electronics. This acquired skill and knowledge would enable student for maintenance similar exploitation of microwave in cyclotron. Student will have a chance to collaborate with WU, Nakorn Srithammarat, ASIPP, China, Rosatom in Russia.		Co-advisors from partner labs outside TINT (if any):
8. Development of mass spectrometry technique for rapid evolution of ultra-trace radionuclides in food and environmental samples	√	Dussadee Rattanaphra and Sasikarn Nuchdang
Scope: The contamination of environment and food with artificial radionuclides originated from nuclear energy technology, the Fukushima nuclear accident etc., has become one of the hot issues of concern for the community and the public. Measurement methods include alpha spectroscopy, liquid scintillation spectrometry, etc., are commonly used methods for determination of ultra-trace radionuclides such as ^{90}Sr, ^{235}U, ^{137}Cs, ^{144}Ce and ^{241}Am in food and environmental samples for risk assessment. Mass spectrometry (ICP-MS), is the promising analytical method with improved technology, high sensitivity, good precision, and higher equipment popularity than radioactive measurement methods. This research focuses on the development of ICP-MS analytical method for determination of ultra-trace radionuclides in food and environmental samples. The rapid determination method with high sensitivity and low detection limit is expected to achieve. The minimum skill for application this course includes a background of chemistry science, applied science, environment science, biological science, biochemical, petroleum science, polymer science, chemical engineering, environmental engineering.		Co-advisors from partner labs outside TINT (if any):

9. Neutron activation analysis (NAA) using research reactor.	√	Kanokrat Tiyapun
NAA is a method for the qualitative and quantitative determination of elements based on the measurement of characteristic radiation from radionuclides formed directly, or indirectly, by neutron irradiation of the material. The most suitable source of neutrons for NAA application is usually a nuclear research reactor. NAA can be performed in a variety of ways depending on the element and the corresponding radiation levels to be measured, as well as on the nature and the extent of interference from other elements present in the sample		
10. Radioisotope production experiment with research reactor.	√	Kanokrat Tiyapun
Radioisotopes have a wide range of applications in various fields, including nuclear medicine, industry, agriculture and research. They are produced mainly in research reactors, involving several interrelated activities such as target fabrication, irradiation, transportation of irradiated targets to processing facilities, radiochemical processing or encapsulation in sealed sources, quality control, and transportation to end users. The production of radioisotopes in reactors is based on neutron capture in a target material (i.e. either by activation or generation of radioisotopes from fission of the target material by bombardment with thermal neutrons). Research to develop new radioisotopes for diagnostics and therapy in nuclear medicine, non-destructive testing and radiotracer industrial applications, as well as for radiotracer studies in scientific research, provides excellent participation opportunities for research reactors.		
11. Electronic part, semiconductor, equipment's parts and silicon transmutation doping experiment using research reactor.	√	Kanokrat Tiyapun
This category includes those applications in which neutrons from research reactor is used to bring about a change in the material properties. The transmutation effects usually require significant fluences to induce the effect within a reasonable time period to electronic part, silicon and semiconductor. The result can be used to diagnostic of the characteristic, electronic equipment, electrical parts, silicon and semiconductor after they have been irradiated.		

12. Neutron imaging using research reactor.	**√**	Kanokrat Tiyapun
The sensitivity of light elements to the absorption of neutrons compared with X ray imaging provides neutron imaging with an advantage in both 2-D and 3-D visualizations. The dominant detection systems for neutron imaging were film based (e.g. X ray film and converters with track etch foils) and known simply as neutron radiography. The experiment can use research reactor with digital processing systems and imaging beam to scan in energy through the range in which structural materials show Bragg diffraction edges.		
13. Simulation using software related to research reactor experiment, shielding, reactor core management, burnup analysis	**√**	Kanokrat Tiyapun
The implementation of the simulator consists of the modeling of the process and system (neutronics, thermal hydraulics), its numerical solution, and the implementation of the man-machine interface through visual interactive screens. The point kinetics model was used for the nuclear process and the heat and mass conservation models were used. The simulation for the shielding can be applied and validated with experiments.		