

e-ASIA Joint Research Program Progress Report

1. Project Title: Development of nano-visualization for structural analyses of genetic materials and early infection process for further innovation of functional bio-nanotechnology

2. Joint Research Period: 1st Jan. 2018 ~ 31st March 2021

3. Principal Investigators:

- Japan: Kiichi Fukui, Specially Appointed Professor, Graduate School of Pharmaceutical Sciences, Osaka University, Osaka, Japan
 - Planned Funding Period: 1st Jan. 2018 ~ 31st March 2021
- Thailand: Kornorn Srikulnath, Assistant Professor, Department of Genetics, Faculty of Science, Kasetsart University, Bangkok, Thailand
 - Planned Funding Period: 1st August 2018 ~ 31st July 2021
- Vietnam: Quoc Bao Nguyen, Associate Professor, Research Institute for Biotechnology and Environment, Nong Lam University, Ho Chi Minh City, Vietnam
 - Planned Funding Period: in-kind contribution (1st Jan. 2018 ~ 31st March 2021)

4. Summary of the Progress of the Joint Research:

As shown in the Fig.1, our joint research program has two scientific objectives. First, nano-structural analysis of genetic materials, such as chromosomes. Second, analysis of early infection processes of microbes to plants. In order to attain these objectives by the aid of nano-technology, we have

developed frequent and tight scientific communications by organizing symposia and workshops among our three teams. So far, we had three symposia at Bangkok, Osaka, Pattaya and two workshops at Osaka and Pattaya. Because in the case of our project not only the exchanges of idea but also transfer of technology are

essential. Thus, we organized workshops to actually use the most advanced equipment in nano-technology, such as Helium

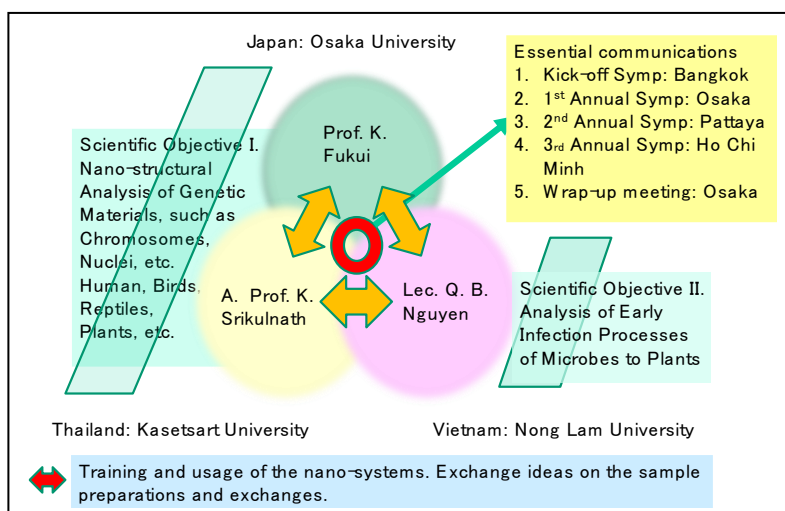


Fig. 1. Organization of our project with three teams from Japan, Thailand, and Vietnam

Ion Microscopy, etc. To develop the wider collaboration of our project, The 3rd Symposium for Functional Nano-biotechnology and 2nd Workshop for Nano-Biotechnology were co-organized with 21st Thai National Genetics Conference at Pattaya. So far our project is actively in progress in total. The individual scientific progresses of the project are summarized as follows.

■ Prof. K. Fukui, Osaka University, Japan: From the beginning of the e-ASIA project, we explored the availability and effectiveness of microscopes and the microscopic methods, such as Transmission Electron Microscopes, Scanning Electron Microscopes, Scanning Transmission Microscope, Focused Ion Beam/SEM. Helium Ion Microscope and TEM tomography and phase contrast electron microscopy, etc., using isolated human chromosomes from cultured cells in collaboration with not only the members within the project but also researchers at Inst. Sci. Indust. Res., Osaka Univ., National Inst. Nano-Tech., Canada, etc. As a result, we revealed that TEM tomography is effective to visualize chromosome scaffold and published the results last year. We are also in the process of publishing articles on the 3D structure of chromatin fibers with human chromosomes in order to achieve original objectives during the e-ASIA project.

■ Assist. Prof. K. Srikuhnath, Kasetsart University, Thailand: Structure and function of scaffold proteins in macro- and microchromosome using three dimensional-structured illumination microscopy (3D-SIM) were analyzed. As a result, double-stranded chromosome scaffold structure that is the same to human and chicken chromosomes have been revealed in the reptile macrochromosome. However, the structure of the reptile microchromosome showed unclear distribution patterns. Then, focused ion beam/scanning electron microscopy (FIB/SEM) will be employed to see more detailed structure. Now, we are prepared metaphase chromosome spread as the samples; duck, crocodiles, snakes, monitor lizards and other lizards using Cytocentrifugation in our colleague from Department of Pathology, Faculty of Medicine, Ramathibodi Hospital, Mahidol University, and also send samples to perform visualization analysis in Japan. As for the analysis on the infection process, the libraries of four AVR-Pik alleles (A, D, E, and F) were developed. Each allele, A, D, E, and F of AVR-Pik was inserted in the expression vector pET28-b.

■ Assoc. Prof. Q. Nguyen, Nong Lam University, Vietnam (engaged by in-kind): Based on the results obtained from the first year regarding the isolation and development of molecular markers on phytopathogenic fungi, *M.oryzae* isolates from *Oryza sativa* pathotypes. We have also successfully developed LAMP technique for rapid detection of two more fungi including *Curvularia lunata* causing brown spot disease in rice and *Lasiodiplodia theobromae* causing canker disease in the rubber tree. Currently, we are in preparation of manuscripts on LAMP based detection of these fungi. Besides the achieved work, we also try to apply Nano particles like AuNP for LAMP technique (LAMP-AuNP) to enhance the visualization of the reaction for in-field detection. Many attempts will focused on this issue in the last one year of this project.

5. Scientific Achievements and Implemented Activities (Research Exchange, Workshop, Publication, etc. if any):

- Research Exchange 1: Symposium to exchange ideas, problems, results obtained.
 - 1) 1st Symposium on Functional Nano-biotechnology at Kasetsart University, Bangkok, Thailand (Kick-off meeting of our project), Feb. 3, 2018
 - 2) 2nd Symposium on Functional Nano-biotechnology at Osaka University, Osaka, Japan, Sept. 17-18, 2018
 - 3) 3rd Symposium on Functional Nano-biotechnology at Pattaya, Thailand (Co-organized with Thai Genetics Society) Jun. 18-21, 2019
 - Research Exchange 2: Workshop to learn new techniques, methods, instrument, etc.
 - 1) 1st Workshop on Nano-Biotechnology at Osaka University, Osaka, Japan, Sept. 19-21, 2018
 - 2) 2nd Workshop on Nano-Biotechnology at Zign Hotel, Pattaya, Thailand, Jun. 18-21, 2019
 - Research Exchange 3: Post-Doc and Student Exchange:
 - 1) One post-doc of Japan side has been sent to show her techniques at the Thailand two times.
 - 2) One Thai student entered to Ph. D. course of Kobe Univ. (One of the members of Osaka group) for the study of nano-biotechnology by the support of JST.
 - Publications:
 - 1) Six articles have already been published.
 - 2) Seven articles are expected to be submitted or published by the end of the project. For example,
 - Toshiyuki Wako, Akiyo Yoshida, Jun Kato, Yuji Otsuka, Shinichi Ogawa, Kohei Kaneyoshi, Hideaki Takata, and **Kiichi Fukui**. Human metaphase chromosome consists of randomly arranged chromatin fibres with up to 30-nm diameter. (Submitted)
 - **Nguyen Bao Quoc**, Nguyen Ngoc Xuan Thanh, Nguyen Doan Nguyen Phuong, Nguyen Ngoc Bao Chau. Development and evaluation of specific LAMP assays for the rapid detection of *Oryza sativa* pathotype of the rice blast fungus, *Magnaporthe oryzae*. (In preparation)
6. Future Goals and Plan of Activities within and after the project period:
- 1) Within the project period: To attain the initial objectives of the project.
 - 2) After the project period: To apply the similar project by the original group.
7. Recommendations and Comments to the Program (if any):
- 1) Within the project period: Support to in-kind team from e.g., indirect expenses is essential to promote the collaboration among teams.
 - 2) After the project period: A few years support to the group that attained good results.

Lists of Achievements and Implemented Activities

1. Original Publication of Articles etc.

1. 1 Original Publications (Articles co-authored among Research Teams)

All Authors' Names, Title, Journal Name, Volume, Edition, Page, Year of Publication	DOI Code	Publication Status	Remarks (e.g. publication in top level journals etc.)

0 Total

1. 2 Original Publications (Articles by Single Team only)

All Authors' Names, Title, Journal Name, Volume, Edition, Page, Year of Publication	DOI Code	Publication Status	Remarks (e.g. publication in top level journals etc.)	Country name of the team
Nobuko Ohmido, Aiko Iwata, Seiji Kato, Toshiyuki Wako and Kiichi Fukui, Development of a quantitative pachytene chromosome map and its unification with somatic chromosome and linkage maps of rice (<i>Oryza sativa</i> L.). PLoS One. 2018 Apr 19; 13(4): e0195710.	doi.org/10.1371/journal.pone.0195710	published		Japan
Mohammed Yusuf, Kohei Kaneyoshi, Kiichi Fukui and Ian Robinson, Use of 3D imaging for providing insights into high-order structure of mitotic chromosomes. Chromosoma. 2018 Sept 3;128:7–13.	doi.org/10.1007/s00412-018-0678-5	published		Japan
Hideaki Takata, Marliza Madung, Kaoru Katoh, Kiichi Fukui, Cdk1-dependent phosphorylation of KIF4A at S1186 triggers lateral chromosome compaction during early mitosis. PLoS One 2018 Dec. 21;13:1–15.	doi.org/10.1371/journal.pone.0209614	published		Japan
Rinyaporn Phengchat, Misa Hayashid, Nobuko Ohmido, Darren Homeniuk, Kiichi Fukui, "3D observation of chromosome scaffold structure using a 360° electron tomography sample holder." Micron 126 102736 (2019)	doi: 10.1016/j.micron.2019.102736.	published		Japan
Misa Hayashida, Kai Cuia, Darren Homeniuk, Rinyaporn Phengchat, Arthur M. Blackburn, Marek Malac, "Parameters affecting the accuracy of nanoparticle shape and size measurement in 3D." Micron 123 102680 (2019)	doi: 10.1016/j.micron.2019.102680.	published		Japan
Aqwin Polosoro, Wening Enggarini, Nobuko Ohmido, "Global epigenetic changes of histone modification under environmental stresses in rice root." Chromosome Res, 27: 287–298. (2019)	doi: 10.1007/s10577-019-09611-3.	published		Japan
Astari Dwiranti, Hideaki Takata, Kiichi Fukui, Reversible changes of chromosome structure upon different concentrations of divalent cations. Microscopy and Microanalysis 2019 June; 25: 817–821.	doi.org/10.1017/S1431927619000266	published		Japan

6 Total

Lists of Achievements and Implemented Activities

2. presentations at Academic Conferences etc. (Seminars, Workshops, Symposia)

2. 1 Conference Presentations (Joint Presentations among Research Teams)

Date	Type of Presentation	Speaker, "Title", Conference Name, Location, etc.

0 Total

2. 2 Conference Presentations (by Single Team)

Date	Type of Presentation	Speaker, "Title", Conference Name, Location etc.	Country name of the team
2017	Oral Presentation	Kiichi Fukui, "Structural analysis of human chromosomes by micro- and nano-technology", The 35th International Conference of the Microscopy Society of Thailand, The Imperial Hotel Chiang Mai, Jan 30 – Feb 2 2018.	Japan
2017	Guest/Invited Speaker	Kiichi Fukui, "Structural analysis of human and plant chromosomes by micro- and nano-technology", 1st e-ASIA Symposium, Kasetsart University Bangkok, Feb 3 2018.	Japan
2018	Oral Presentation	Kiichi Fukui, "Contribution of micro- and nano-technology to chromosome science, 6th Asia-Pacific Chromosome Colloquium, Canberra, July 4 2018"	Japan
2018	Guest/Invited Speaker	Nobuko Ohmido, "Molecular cytogenetics for plant genetics and breeding, 6th Asia-Pacific Chromosome Colloquium, Canberra, July 4 2018"	Japan
2018	Oral Presentation	Aqwin Polosoro, Wening Enggarini and Nobuko Ohmido "Cytological effect of histone modification and retrotransposon transcription by iron stress in rice". 6th Asia-Pacific Chromosome Colloquium, Canberra, 5 July 2018	Japan
2018	Oral Presentation	Hideaki Takata, "Studies on the condensation mechanism of mitotic chromosomes and its biological significance", 6th Asia-Pacific Chromosome Colloquium, Canberra, July 5 2018	Japan
2018	Guest/Invited Speaker	Kiichi Fukui, "Chromosome, as a key element of genetics and genomics", iJaDe2018, Kobe, Sept 6 2018.	Japan
2018	Guest/Invited Speaker	Nobuko Ohmido, "Histone dynamics of single cell in plant development and environment" iJaDe2018, Kobe, Sept 6 2018.	Japan

2018	Guest/Invited Speaker	Kiichi Fukui, "Contribution of nanotechnology towards chromosome structural analysis". 2nd e-ASIA Symposium, Osaka, Sept 17 2018	Japan
2018	Oral Presentation	Nobuko Ohmido, "Chromosome mapping for rice genetics and breeding", 2nd e-ASIA Symposium, Osaka, Sept 17 2018"	Japan
2018	Oral Presentation	Hideaki Takata, "Chromosomal proteins required for authentic chromosome morphology", 2nd e-ASIA Symposium, Osaka, Sept 17 2018"	Japan
2018	Oral Presentation	Toshiyuki Wako, "Nano-order imaging of chromosome structure", 2nd e-ASIA Symposium, Osaka, Sept 18 2018.	Japan
2018	Oral Presentation	Rinyaporn Phengchat, "Structure of chromosome scaffold revealed by nano-technology", 2nd e-ASIA Symposium, Osaka, Sept 18 2018.	Japan
2018	Oral Presentation	Kiichi Fukui, "Nano-technology: approaching the long lasting enigma of chromosome structure", Chromosome Colloquium, Olmouc, Czech Rep., Dec. 11 2018	Japan
2018	Guest/Invited Speaker	Nobuko Ohmido, "Insight of chromosome and chromatin dynamics in plants", Chromosome Colloquium, Olmouc, Czech Rep., Dec. 11 2018.	Japan
2018	Guest/Invited Speaker	Kiichi Fukui, "Chromosome: A fascinating target of recent nano-technology", University of Silesia, Dec. 12 2018	Japan
2018	Guest/Invited Speaker	Nobuko Ohmido "Dynamic behavior of plant chromosome in development and environment", University of Silesia, Dec. 12 2018	Japan
2018	Guest/Invited Speaker	Kiichi Fukui, "Chromosome: A fascinating target for nano- and micro-biology", Jagiellonian University, Dec.13 2018	Japan
2018	Guest/Invited Speaker	Nobuko Ohmido "Visualization insights into differentiation and development in plant cell", Jagiellonian University, Dec.13 2018	Japan
2019	Guest/Invited Speaker	Kiichi Fukui "From optical imaging to nano-imaging for chromosomeresearch", 21st National Genetics Conferences, Pattaya, Thailand, 21 June 2019	Japan
2019	Guest/Invited Speaker	Kiichi Fukui "Human chromosome interior revealed by FIB/SEM method", The 3rd eASIA international symposium, Pattaya, Thailand, 18 June 2019	Japan
2019	Guest/Invited Speaker	Nobuko Ohmido "Insights of cytogenetics research for rice genetics and breeding.", 21st National Genetics Conferences, Pattaya, Thailand, 20 June 2019	Japan
2019	Guest/Invited Speaker	Nobuko Ohmido "Histone dynamics under environmental stress in plants", The 3rd eASIA international symposium, Pattaya, Thailand, 18 June 2019	Japan
2019	Guest/Invited Speaker	Channarong Sartsanga, Rinyaporn Phengchat, Kiichi Fukui, Nobuko Ohmido "Development of nano-visualization for structural analyses of chromosome" The 3rd international symposium. e-Asia meeting, Pattaya, 18 June 2019	Japan
2019	Oral Presentation	Rinyaporn Phengchat "Electron tomography for single chromosome observation. The 3rd international symposium. The 3rd international symposium." e-Asia meeting, Pattaya, 18 June 2019	Japan
2019	Oral Presentation	Nobuko Ohmido, Aqwin Polosoro "Epigenetical chromatin dynamics under abiotic stresses in rice. ", 12th International Symposium Exploring the Global Sustainability. Osaka, 5 August 2019	Japan
2019	Guest/Invited Speaker	Rinyaporn Phengchat, Misa Hayashida, Nobuko Ohmido, Darren Homeniuk, Kiichi Fukui "Visualization of chromosome scaffold structure using electron tomography", 神戸, 財団法人染色体学会第70回年会, 2019年9月23日	Japan

2019	Oral Presentation	Yi Kun Liu, Yeng Mun Liaw, Petr Cápál, Jaroslav Doležel, Chee How Teo, Naoki Wada, Kiichi Fukui, Nobuko Ohmido "Reconstruction of Arabidopsis chromosome in human-plant hybrid cell". 財団法人染色体学会第70回年会, 神戸, 2019年9月23日	Japan
2019	Poster Session	近江戸伸子, Aqwin Polosoro "環境ストレス条件下での植物細胞のエピジェネティック変動" 財団法人染色体学会第70回年会, 神戸, 2019年9月24日	Japan
2019	Oral Presentation	Aqwin Polosoro, Wening Enggarini, Toto Hadiarto, and Nobuko Ohmido "Morphology changes of rice root nucleus under iron stress." The 1st International Conference on Agriculture and Rural Development (ICARD), Serang City, Banten, Indonesia, 8-9 August 2019	Japan
2019	Oral Presentation	Nobuko Ohmido "Insight of epigenetical chromatin dynamics in plant cell" 5th Nano- Chromosome workshop, Osaka, 20 Feb 2020	Japan
2019	Oral Presentation	Channarong Sartsanga, Rinyaporn Phengchat, Petr Cápál, Jaroslav Doležel, Kiichi Fukui, Nobuko Ohmido "Isolation of Barley chromosome for tomography analysis", 5th Nano- Chromosome workshop, Osaka, 20 Feb 2020	Japan
2019	Oral Presentation	Rinyaporn Phengchat "Usage of ascorbate peroxidase for chromosome scaffold imaging with electron microscope", 5th Nano- Chromosome workshop, Osaka, 20 Feb 2020	Japan
2019	Oral Presentation	Liu yikun Liu YK, Liaw YM, Cápál P, Teo CH, Wada N, Fukui K, Doležel J, Ohmido N "Complex genomic and chromosome rearrangement in Human-Arabidopsis hybrid", 5th Nano- Chromosome workshop, Osaka, 20 Feb 2020	Japan
2019	Oral Presentation	Hideaki Takata "A novel protein phosphorylation required for chromosome organization" 05th Nano- Chromosome workshop, Osaka, 20 Feb 2020	Japan
2019	Oral Presentation	Kiichi Fukui "Historical perspective of chromosomeresearch and its future trend" 5th Nano- Chromosome workshop, Osaka, 20 Feb 2020	Japan
June 18, 2019	Oral Presentation	Kornsorn Srikulnath, "Why do some animals have both macro- and microchromosomes?", 3rd international Symposium and 2nd international workshop of Functional bio-nanotechnology, Zign hotel, Pattaya, Thailand	Thailand
June 18, 2019	Oral Presentation	Worapong Singchat, "Dynamics of macro- and microchromosome in snakes?", 3rd international Symposium and 2nd international workshop of Functional bio-nanotechnology, Zign hotel, Pattaya, Thailand	Thailand
June 19, 2019	Oral Presentation	Chatchawan Jantasuriyarat, "Rice blast disease and How to detect the phatogenicity of Rice blast fungus?", 3rd international Symposium and 2nd international workshop of Functional bio-nanotechnology, Zign hotel, Pattaya, Thailand	Thailand
June 19, 2019	Oral Presentation	Gasidit Panomsuwan, "Solution plasma synthesis of Colloidal gold nanoparticles and their applications", 3rd international Symposium and 2nd international workshop of Functional bio-nanotechnology, Zign hotel, Pattaya, Thailand	Thailand
June 19, 2019	Oral Presentation	Jidapa Chantaramethakul, "Effect of solution medium on Morphology of Gold nanoparticles synthesized using Solution plasma process", 3rd international Symposium and 2nd international workshop of Functional bio-nanotechnology, Zign hotel, Pattaya, Thailand	Thailand
June 19, 2019	Oral Presentation	Nguyen Bao Quoc, "Loop-mediated isothermal amplification (LAMP) assay for rapid detection and differentiation of M.oryzae isolates among different host "	Vietnam
	42	Total	

Lists of Achievements and Implemented Activities

3. Workshops, Seminars, Symposia and Other Events (Organized by the Project)

Event duration	Name of Organizer	Title of the Event	Location (Country, City, Venue)	Number of Participants (Including Team Members)	Overview
Feb. 3, 2018	Kornsorn Srikulnath	1st e-ASIA Symposium on Functional Nabobiology	Thailand, Bangkok, Kasetsart University	18	Kick-off meeting
Sep. 17-18, 2018	Kiichi Fukui	2nd e-ASIA Symposium on Functional Nabobiology	Japan, Osaka, Osaka University	25	
Sep. 19-21, 2018	Kiichi Fukui	1st e-ASIA Workshop on Functional Nabobiology	Japan, Osaka, Osaka University	25	Helium Ion Microscopy
Jun. 18-21, 2019	Kornsorn Srikulnath	3rd e-ASIA Symposium on Functional Nabobiology	Thailand, Pattaya, Zign Hotel	120	第21回タイ国遺伝学会と共催
Jun. 18-21, 2019	Kornsorn Srikulnath	2nd e-ASIA Workshop on Functional Nabobiology	Thailand, Pattaya, Zign Hotel	120	第21回タイ国遺伝学会と共催
Feb. 19-20, 2020	Kiichi Fukui	5th Nano- Chromosome Workshop	Japan, Osaka, Osaka Univ. and AIST	12	Natl. Inst. Nanotech, Canada および産総研と共催
6	Total				

Lists of Achievements and Implemented Activities

4. Record of Research Exchanges

Date of Departure	Date of Return	Last Name & First Name	Country of Affiliation	Affiliation	Position	Exchange Destination (Country, City, Research Organization etc.)	Description of Exchange Content/Purpose	Duration of Exchange (autocompleted)
2018/1/29	2018/2/4	Fukui Kiichi	Japan	Osaka University	Asppointed Professor	Thailand Bangkok , Kasetsart University	oral presentation *workshop	7
2018/2/2	2018/2/4	Ohmido Nobuko	Japan	Kobe University	Professor	Thailand Chengmai Bangkok Imperial Hotel, Kasetsart University	workshop	3
2018/7/2	2018/7/8	Fukui Kiichi	Japan	Osaka University	Asppointed Professor	Austraria, Cambera, Cambera Univ.	oral presentation	7
2018/7/2	2018/7/8	Takata Hideaki	Japan	AIST	chief researcher	Austraria, Cambera, Cambera Univ.	oral presentation	7
2018/7/2	2018/7/8	Ohmido Nobuko	Japan	Kobe University	Professor	Austraria, Cambera, Cambera Univ.	oral presentation	7
2018/7/2	2018/7/8	Wako Toshiyuki	Japan	NARO	chief researcher	Austraria, Cambera, Cambera Univ.	oral presentation	7
2018/12/8	2018/12/15	Fukui Kiichi	Japan	Osaka University	Asppointed Professor	Czech, Poland Olomouc Experimental Plant	discussion	8
2018/12/8	2018/12/15	Ohmido Nobuko	Japan	Kobe University	Professor	Czech, Poland Olomouc Experimental Plant	discussion	8
2019/1/18	2019/1/24	Fukui Kiichi	Japan	Osaka University	Asppointed Professor	Canada Edtmonton National Institute of Nanotechnology	discussion	7
2019/6/12	2019/6/27	Rinyaporn Phengchat	Japan	Kobe University	researcher	Thailand Bangkok Pataya, Phattaya, Kasetsart University	workshop * experiment	16
2019/6/14	2019/6/16	Fukui Kiichi	Japan	Osaka University	Asppointed Professor	Vietnam Ho-Chi-Minh Nong Lam Univ.	discussion	3
2019/6/17	2019/6/22	Fukui Kiichi	Japan	Osaka University	Asppointed Professor	Thailand Pataya, Phattaya, 21st Gene Conference Thailand	invited lecture * workshop	6
2018/9/15	2018/9/19	Marek Malac	Japan	National Inst. Nanotech. Canada	Senior Researcher	Japan, Osaka, Osaka University	Lecture	5
2018/9/15	2018/9/19	Misa Hayashida	Japan	National Inst. Nanotech. Canada	Researcher	Japan, Osaka, Osaka University	Lecture	5
2019/2/6	2019/2/7	Misa Hayashida	Japan	National Inst. Nanotech. Canada	Researcher	Japan, Osaka, Osaka University	Discussion	2
2019/8/25	2019/9/22	Astari Dwiranti	Japan	Indonesia Univ.	Researcher	Japan, Osaka, Osaka University	Discussion, Experiments	29
2019/8/25	2019/9/22	Fendi Arifudin	Japan	Indonesia Univ.	Student	Japan, Osaka, Osaka University	Discussion, Experiments	29
2019/8/25	2019/9/22	Aldi Siregar	Japan	Indonesia Univ.	Student	Japan, Osaka, Osaka University	Discussion, Experiments	29
2019/11/19	2019/11/26	Misa Hayashida	Japan	National Inst. Nanotech. Canada	Researcher	Japan, Osaka, Osaka University	Discussion, Experiments	8

2020/1/5	2020/1/19	Astari Dwiranti	Japan	Indonesia Univ.	Researcher	Japan, Osaka, Osaka University	Discussion	15
2020/1/5	2020/1/19	Fendi Arifudin	Japan	Indonesia Univ.	Student	Japan, Osaka, Osaka University	Discussion	15
2020/2/20	2020/2/21	Harada Ken	Japan	RIKEN	researcher	Japan, Osaka, Osaka University, AIST	Discussion, workshop	2
June 18, 2019	June 19, 2019	Kornsorn Srikulnath	Thailand	Kasetsart University	Associate Professor	Zign hotel, Pattaya, Thailand	3rd international Symposium and 2nd international workshop of Functional bio-nanotechnology	2
June 18, 2019	June 19, 2019	Chatchawan Jantasuriyarat	Thailand	Kasetsart University	Associate Professor	Zign hotel, Pattaya, Thailand	3rd international Symposium and 2nd international workshop of Functional bio-nanotechnology	2
June 18, 2019	June 19, 2019	Gasidit Panomsuwan	Thailand	Kasetsart University	Dr.	Zign hotel, Pattaya, Thailand	3rd international Symposium and 2nd international workshop of Functional bio-nanotechnology	2
June 18, 2019	June 19, 2019	Worapong Singchat	Thailand	Kasetsart University	PhD student	Zign hotel, Pattaya, Thailand	3rd international Symposium and 2nd international workshop of Functional bio-nanotechnology	2
June 18, 2019	June 19, 2019	Jidapa Chantaramethakul	Thailand	Kasetsart University	PhD student	Zign hotel, Pattaya, Thailand	3rd international Symposium and 2nd international workshop of Functional bio-nanotechnology	2
17/6/2019	20/6/2019	Nguyen Bao Quoc	Vienam	Nong Lam University	Associate Professor	Zign hotel, Pattaya, Thailand	the third symposium and the second international workshop on functional bio-nanotechnology	2
17/6/2019	20/6/2019	Nguyen Doan Nguyen Phuong	Vienam	Nong Lam University	Project member	Zign hotel, Pattaya, Thailand	the third symposium and the second international workshop on functional bio-nanotechnology	2
				Total (Person)	29		Total (Person-day)	239

Lists of Achievements and Implemented Activities

5. Patent Applications

5. 1 Independent Applications by Single Team

Application Number	Name of Patent/ Patent Name	Application Date	Patent Applicants (Fill in All Members)	Publication Number (leave blank if unpublished)	Inventor	Country of Application	Registration Number (leave blank if unregistered)	Country Name of the Team

0

Total (Number of Application)

0

Total (Number of Registration)

5. 2 Joint Applications

Application Number	Name of Patent/ Patent Name	Application Date	Patent Applicants (Fill in All Members)	Publication Number (leave blank if unpublished)	Inventor	Country of Application	Registration Number (leave blank if unregistered)

0

Total (Number of Application)

0

Total (Number of Registration)

Lists of Achievements and Implemented Activities

6. Awards

Date of Award	Name of Award	Recipient	Remarks	Country Name of the Team

0

Total