

**Summary of Proposal** (Compile in English within 3 pages.)

**Host institution:** Nagoya University

**Head of host institution:** Seiichi Matsuo (President)

**Research center:** Institute of Transformative Bio-Molecules (ITbM)

**Center director:** Kenichiro Itami

**Chief center-project officer** (in December 2012): Kenichiro Itami (Director)

**Administrative director:** Tsuyoshi Matsumoto

## 1) Project summary

ITbM was launched at Nagoya University (NU) as a unique research center to develop “transformative bio-molecules” that make a marked change in the form and nature of biological science and technology. Many interdisciplinary research projects have emerged rapidly in the “Mix Lab”, where new unique ideas in research are being generated from daily communications among the researchers from different fields who work side-by-side. As a result, a number of new bio-functional molecules and molecular technologies has been developed. Many of the research outcomes have been filed for patents and published as joint publications between different research groups. According to the Center’s research progress, ITbM has defined its flagship projects as “Plant Chemical Biology”, “Chemical Chronobiology”, and “Chemistry-enabled Live Imaging”. ITbM will focus on these flagship research areas and will work to actively promote chemical biology research to “understand”, “see”, and “regulate” living organisms by establishing new interdisciplinary research fields between chemistry and biology. This is expected to lead to the creation of transformative bio-molecules.

## 2) Mission statement and/or center’s identity

The mission of ITbM is to develop diverse functional molecules that bring about innovative impact on the principle of biological systems. To accomplish this, we will harness our synthetic abilities based on molecule-activation chemistry. We seek to effect a paradigm shift in science by creating a new field of research that aims to implement programmed chemical transformations for precisely controlling the production of bio-functional molecules of requisite structures and their functional expressions. The identity of ITbM resides in the development of novel bio-molecules that will achieve this goal. To accomplish this, we will enlist the best synthetic chemists and plant and animal biologists worldwide.

## 3) Research fields

ITbM’s research to develop “transformative bio-molecules” is closely related to the fields of synthetic chemistry, molecular catalysis, functional molecular science, systems biology, plant science, plant genetics, plant developmental biology, animal physiology, protein science, and bio-imaging. These are areas in which NU has significant international competitive advantages. We plan to bring this to a new level by exploiting cutting-edge synthetic chemistry partnered with fundamental biological systems of plants and animals. This research endeavor will have significant impacts in closely related fields of chemical biology and medicinal chemistry, but most importantly, on areas that are of urgent global importance including world food production, medical care, and bioenergy.

## 4) Research objectives

Since ITbM’s establishment in 2013, novel synthetic small bio-molecules have been developed. Molecule-initiated biology (chemical biology) to create transformative bio-molecules is currently shifting to the next phase, i.e., understanding and controlling biological processes by utilizing the molecules

developed at ITbM.

At such a turning point, ITbM has defined the following flagship research areas based on ITbM's research achievements so far: **plant chemical biology**, **chemical chronobiology**, and **chemistry-enabled live imaging**. ITbM will focus on these flagship research areas and will work to actively promote chemical biology research to "understand", "see", and "regulate" living organisms by establishing new interdisciplinary research fields between chemistry and biology, which will lead to the creation of transformative bio-molecules.

## 5) Outline of management

ITbM will take number of measures to remove the barriers that hinder interdisciplinary research and internationalization thereby triggering a fundamental transformation of existing academic systems.

- The Center Director will have the authority to make the final decisions over the appointments of personnel, the Center budget, and research priorities etc.
- Steering Committee meeting and PI meeting are held to provide advice to the Center Director.
- A rigorous evaluation of researchers will be made, and the results will be reflected in the salaries of researchers.
- We will establish an effective and efficient Administrative Department with English-speaking staff for accelerating the internationalization of ITbM as well as promotion of the fusion of different research fields.
- The Administration Department is led by Administrative Director with a strong background of scientific research and is composed of Management Division, Research Promotion Division (RPD), and Strategic Planning Division (SPD).

## 6) Researchers and other center staffs, satellites, partner institutions

As of the end of FY2016, ITbM consists of 72 researchers including 13 PIs (8 NU PIs, 5 overseas PIs), 47 research support staffs, and 13 administrative staffs. In addition, students conducting research at each PI group are involved in the research projects at ITbM.

The overseas PIs are talented researchers in their field and will have double affiliations with their host institute and NU. We introduced a system of Co-Principal Investigators (Co-PIs) to: (1) ensure close contact with ITbM's researchers and continuity in research; and (2) mentor leading young researchers. Young faculties are appointed to overseas PI groups. The Co-PIs will be based at Nagoya, where they are selected and guided by the overseas PIs for actively managing their research groups in ITbM. This will facilitate research in Japan and also help train young researchers (Co-PIs) to become leaders of the next generation.

**Cooperating Institutes:** Queen's University (Canada), University of Washington (USA), ETH Zürich (Switzerland), University of Southern California (USA), University of Düsseldorf (Germany), National Science Foundation Center for Selective C-H Functionalization (NSF-CCHF, USA), Institute for Basic Science (IBS, KAIST, Korea), University of Freiburg (Germany), Academia Sinica (Taiwan), and RIKEN Center for Sustainable Resource Science (CSRS, Japan).

## 7) Outline of research environment

- (1) We established a Mix-Lab system, where international young researchers from different fields work together in order to accelerate multidisciplinary advances through informal discussions on a daily basis.
- (2) To make the overseas PIs' research at ITbM possible, ITbM decided to employ young researchers as Co-PIs who stay full time at ITbM and cooperate with the overseas PIs.
- (3) In order to enable NU PIs to focus on their research, NU provided permission to employ 7 Associate Professors and Lecturers as Co-PIs of ITbM to conduct educational tasks in the place of NU's PIs.
- (4) All postdoctoral researchers will be supervised by two PIs from different fields in order to accelerate collaboration and nurture the next generation of cutting-edge research, unrestricted by the bounds of traditional disciplines.
- (5) In order to ensure to welcome talented overseas researchers to ITbM, we will provide the following:

(a) a team for assisting overseas researchers in their applications for competitive domestic (Japanese) research grants; (b) opportunities for partners/spouses to hold positions in the University based on their skill sets; and (c) adequate information on education opportunities for the children of overseas researchers. Through these endeavors, we have set a platform for overseas PIs to allocate a significant portion of their activities at Nagoya, and we aim to attract a certain percentage of overseas researchers permanently to Nagoya.

- (6) Each PI group will be provided with sufficient research space and start-up funds.
- (7) We will be equipped with leading edge equipment and facilities at NU, staffed with expert technical managers, so that it is fully accessible for promoting research, international collaborations, and discoveries.
- (8) We will engage in high-profile recruitment campaigns to attract highly qualified postdoctoral researchers using web sites with high global status, outlining the current efforts of the Institute, University, and Nagoya as a city.

### 8) Outline of indicators for evaluating a center’s global standing

Three aspects are important for the global standing of ITbM:

- 1) research quality and impact, 2) breakthroughs resulting from interdisciplinary research activities, and 3) human resources development as an international institute.

The following quantitative metrics will be used for evaluation: number of peer-reviewed publications (impact factor, citations), application to patent files, technology transfer and commercialization, awards and honors, research grants, and career promotion of ITbM’s researchers.

### 9) Securing research funding

ITbM’s researchers have been constantly obtaining competitive funding from ITbM’s establishment. The total amount acquired nearly matches the project grant at the beginning, and became more than double in FY2013. The amount has further increased in the following years. We will continue our effort to secure competitive research funds. Major competitive funding obtained in FY2016 are as follows: JST-ERATO (2 projects), JST-CREST (2 projects), JST-PRESTO (2 projects), Grant-in-Aid for Scientific Research on Innovative Areas (2 project as Area Representative), JST-ALCA (1 project), Grant-in-Aid for Specially Promoted Research (1 project) etc. Overseas PIs have also been successful in obtaining KAKENHI (Grant-in-Aid for Scientific Research) from FY2014.

### 10) Appropriations plan

Appropriations plan	FY	2017	2018	2019	2020	2021	Total
(Exchange Rate: JPY/USD=100)	Cost (\$ millions)	7.0	7.0	7.0	7.0	7.0	35.0

(Exchange Rate: JPY/USD=100)

### 11) Summary of host institution’s commitment

NU has placed ITbM as a significant research institute conducting world-leading frontier basic research at NU in the University’s mid-term plans and in “Nagoya University Matsuo Initiatives for Reform, Autonomy, and Innovation 2020 (NU MIRAI 2020)”. The presence of ITbM is essential for NU to become a research university that can compete with leading universities in the world. NU is committed to supporting ITbM through all means. Under the umbrella of the “Institute for Advanced Research”, ITbM will receive additional support needed to manage ITbM even after termination of funding from the WPI program. Representative concrete measures are 1) provision of space, 2) financial support towards construction of ITbM’s new building, 3) support towards the operation of the new building, 4) covering salaries of faculties, 5) ITbM’s priority to the use of hall of residence.