

Introduction of Condensed Matter Nuclear Science at Tohoku University

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Abstract

A new division devoted to Condensed Matter Nuclear Reactions (CMNR) was established at the Research Center for Electron Photon Science of Tohoku University in April 2015. This is the first official research division for condensed matter nuclear science and its application in Japan. This division consist of researchers from Tohoku University, Mitsubishi Heavy Industries and Clean Planet Inc., who have been actively engaged in the field of CMNR. In this division, fundamental research on condensed matter nuclear reaction, and R&D on energy generation and nuclear waste decontamination, will be performed.

1. Purpose of the Division

With the aim of creating revolutionary innovation in the energy industry, the Research Center for Electron Photon Science at Tohoku University and Clean Planet Inc. have established a Condensed Matter Nuclear Reaction Division. Through this new joint research collaboration, we will perform the following:

- 1) Fundamental research on Condensed Matter Nuclear Reactions (CMNR)
- 2) Development of a new energy generation method
- 3) Development of a new nuclear waste decontamination method

Experimental data that indicates the presence of CMNR has been accumulated and experimental conditions for inducing CMNR are gradually becoming clear, although systematic experimental studies are still insufficient. So we will obtain more systematic data and improve the reliability of measurements of CMNR. That should lead to better understanding of ultra-low-energy nuclear reactions in condensed matter. We will also work on application development research aimed at commercializing new clean energy devices and new nuclear waste decontamination methods. We hope to bring major changes to Japan's energy industry, through the conceptual change of conventional nuclear reactions.

2. Organization of the Division

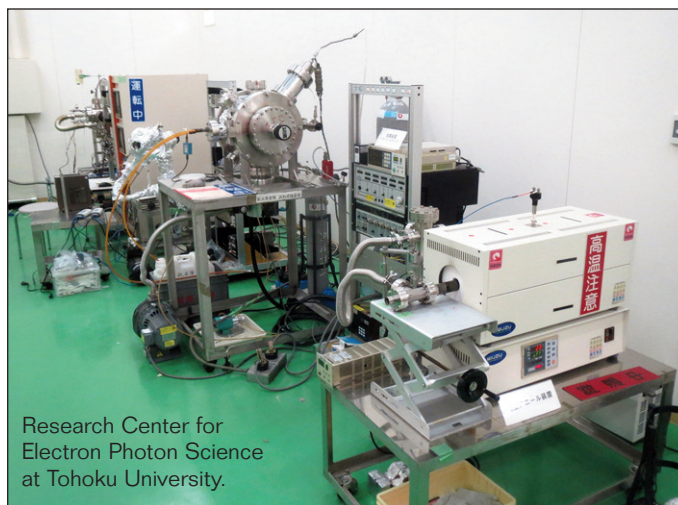
The organization of the new division is illustrated in Figure 1. Jirohta Kasagi, Yasuhiro Iwamura, Hidetoshi Kikunaga, Takehiko Itoh and Hideki Yoshino participate in the division.

Iwamura and Itoh were investigating nuclear transmutation reactions observed in the nano-sized Pd complexes induced by D₂ gas permeation. They left Mitsubishi Heavy Industries, Ltd. at the end of March 2015 to join the division. Now, Iwamura is a research professor of Tohoku University and Itoh is a visiting associate professor. Itoh is also a director of Clean Planet Inc. Kasagi is a professor emeritus, who has been investigating the electronic and ionic screening effects on low-energy nuclear reactions in condensed matter. Kikunaga is an associate professor and has been engaged in the field of radiochemistry. Yoshino is a visiting researcher in this division and also a CEO of Clean Planet Inc. In addition, doctoral and master course students are helping our research, but actually, only Itoh, Kasagi and Iwamura are the research forces for this division.

The nuclear waste decontamination research is supported as a feasibility study by the ImPACT Program "Reduction and Resource Recycle of High Level Radioactive Wastes with Nuclear Transformation," which is a Japanese national research project. The Electron Photon Science of Tohoku University and Mitsubishi Heavy Industries jointly participate in this project.

3. Research Plan

The outline of our research plan is shown in Figure 2. As for excess heat generation, we will seek the most probable



method for energy generation for two years. We will try new methods of excess heat generation based on Mizuno's methods and the transmutation method induced by D₂ gas permeation. It is very important to measure the released heat precisely as well as to evaluate correct input power. We will develop an elementary method for energy generation until FY2016, and we will ascertain its feasibility as a new energy source. The focus in this stage will be on controllability and reliability of energy production reactions.

A research program aimed toward the confirmation of anomalous excess heat using nano-metals, which is spon-

sored through the New Energy and Industrial Technology Development Organization (NEDO), began on October 26, 2015. A joint research team of six institutions (two companies: Technova and Nissan; four universities: Tohoku, Kyushu, Nagoya and Kobe) will carry out the first year program until October 31, 2016. The experimental program will involve four areas:

- a) development of a new calorimetry system at Tohoku University with the assistance of Technova;
- b) joint experiments to analyze for excess heat using nano-

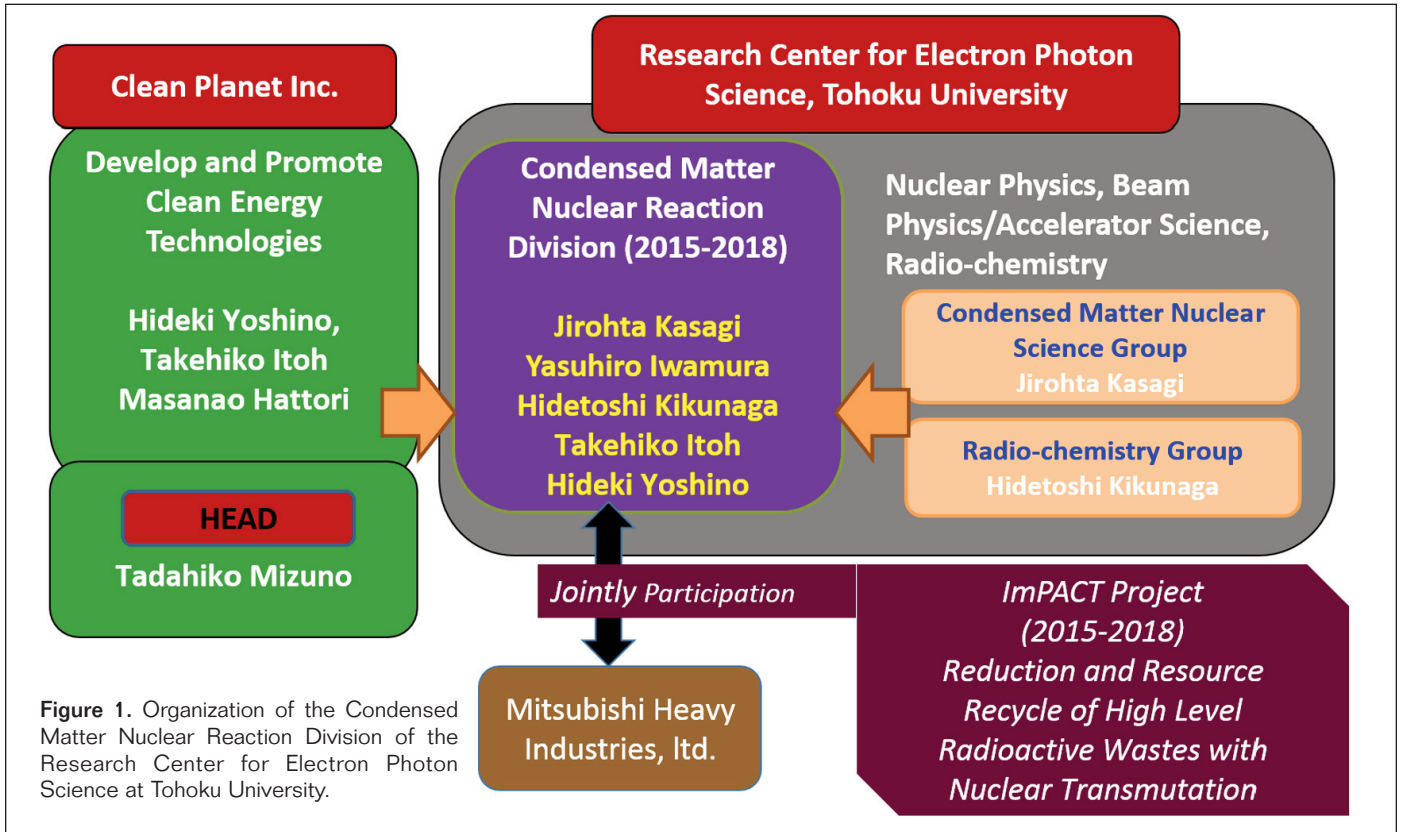


Figure 1. Organization of the Condensed Matter Nuclear Reaction Division of the Research Center for Electron Photon Science at Tohoku University.

	FY 2015	FY 2016	FY2017	FY2018
Excess Heat Generation	Seeking for the Most Probable Method for Energy Generation		Ascertain its Feasibility	
Nuclear Transmutation	Transmutation of Stable Elements, NAA of Products		Transmutation of Radioactive Isotopes for Nuclear Waste Decontamination	

Figure 2. Outline of the Tohoku University research plan.

metal composite samples with gas-loading experiments at Kobe University and other laboratories;
c) materials science research at Nagoya University and Kyushu University; and
d) evaluation and survey studies by Technova and Nissan.

We hope to achieve the first year targets and to proceed for the second year extended plan.

Dr. Sasaki, who is visiting professor in the planning section of the school of engineering of Tohoku University, has given much attention for our research activity. He explained our research results to the professors in the school of engineering. Then, Dr. Hashizume, who is a professor of Department of Quantum Science and Energy Engineering, decided to send a graduate student of the doctoral course into our division. Our collaboration has just started this month and we are now planning our joint research.

Nuclear transmutation research will be performed with funding from the ImPACT program. Pr, which is transmuted from Cs, will be re-confirmed by other methods such as RBS (Rutherford Backscattering). We will confirm that Pr is transmuted from Cs by RBS. Stable Zr, Se and Pd transmutation will be tried using the transmutation method in the nano-sized Pd complexes induced by D₂ gas permeation. If we obtain the positive results, we will be able to go to the next stage. We will make transmutation experiments using radioactive isotopes for nuclear radioactive waste decontamination after FY2016.

Fundamental Research on Condensed Matter Nuclear Reactions (CMNR) will be performed through these two research activities. We hope to clarify what is happening during CMNR by obtaining systematic experimental data.

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