

# Country History of Japanese Work on Cold Fusion

- Toward a further development of Condensed  
Matter Nuclear Science -

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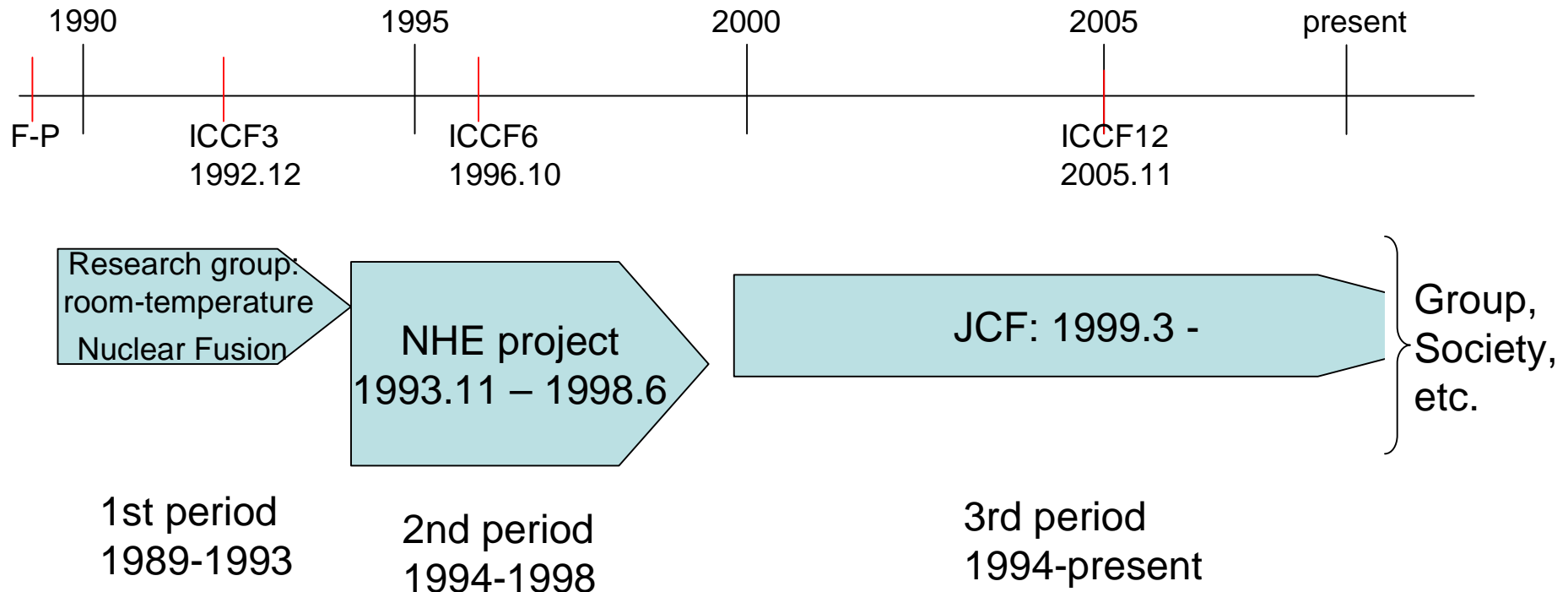
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# Introduction

- Kasagi and Iwamura were asked to edit a document on “cold fusion” research in Japan.
- There exist many official reports for various projects and proceedings of domestic meetings on “cold fusion”. We consider that the document should be edited based on them.
- Editing is still in preliminary stage.
- Since work of Profs. Arata and Zhang is introduced in the special session in this conference, we focus on other works in this presentation.
- As we did not discuss enough with persons concerned, we welcome various comments from Japanese colleagues.

# Outline

In Japan, many researchers and groups have been connected (not tightly) with each other, and formed a kind of research community which plays an important role for obtaining research fund, information exchange, organizing co-operative studies, holding workshops and meetings, etc.  
From this point of view, the history can be divided into three periods.



1st period: 1989 - 1993

# Research group for room-temperature nuclear fusion

1989.6 group for systematic, co-operative research and information exchange about 40 researchers (15 universities and NIFS); initiative of Prof. H. Ikegami  
one-year special support from Grant-in-Aid of Priority Area of Nuclear Fusion

1989.12 number of researchers in the group; 110 researchers  
26 Universities, 5 Research Institutes

1990.4 Grant-in-Aid of Scientific Research (by Ministry of Education)  
Study of Cold Nuclear Fusion (representative: Prof. Ikegami)  
Small amount of grant: 20 M JPY for 2 Fiscal Years  
not enough for experimental equipments  
meeting, information exchange, travel expenses

1992.3

1992.10 ICCF3 at Nagoya (230 Japanese participants)  
Takahashi Method, Yamaguchi experiment, .....

1993.1 World-wide Investigation on status of cold fusion by Technova Inc.

↓  
1993.11 New Hydrogen Energy (NHE) project

1st period: 1989 - 1993

## Characteristics of the first period

Many experiments were performed by many groups in the first stage.  
Universities, National Labs and Companies

Hydrogen absorption in Pd  
High sensitive Neutron detector  
Neutron detection in electrolysis  
2.45 MeV peak in neutron spectrum  
Charged particle detection  
Tritium  
Impact fusion (beam experiments)

} Study of Cold Nuclear Fusion  
Grant-in-Aid for Scientific Research  
representative: Prof. Ikegami

Grant-in-Aid for scientific research by Ministry of Education

4 groups got the grants in addition to Ikegami's.

Tokyo U. (1990-91, Totsuka G), Tohoku U. (1990-91, Yamaguchi G),  
Osaka U. (1990-91, Baba G), Yokohama N. U. (1992, Ohta G)

from data base for Grant-in-Aid in Scientific Research

Application of a larger project (Grant-in-Aid of Priority Area of Nuclear Reactions in Condensed Matter; Prof. Okamoto) for 1992 – 1995 was not succeeded.

1st period: 1989 - 1993

## Contributions from Japan of this period were concentrated in ICCF3

10 invited papers from Japan

Excess Heat:

K. Kunitatsu et al., N. Oyama et al., K. Ohta et al., A. Takahashi et al.

Nuclear Product:

M. Nakada et al., E. Yamaguchi and T. Nishioka, T. Iida et al., J. Kasagi et al.

Materials and Hydrogen Behavior:

M. Enyo, Y. Fukai

Prof. Ikegami remarked in Preface of the Conference Proceedings

Takahashi Method (L-H mode Electrolysis)

Yamakaguchi & Nishioka as the most important work

# 1st period: 1989 - 1993 Yamaguchi & Nishioka

## Direct Evidence for Nuclear Fusion Reactions in Deuterated Palladium

### Proceedings of ICCF3

Yamaguchi, E. and T. Nishioka, *Cold fusion induced by controlled out-diffusion of deuterons in palladium*. Jpn. J. Appl. Phys. Part 2, 1990, 29(4): p. L666.

YAMAGUCHI Eiichi and NISHIOKA Takashi

NTT Basic Research Laboratories

3-9-11 Midori-cho, Musashino-shi, Tokyo 180, JAPAN

## Cold Nuclear Fusion Induced by Controlled Out-Diffusion of Deuterons in Palladium

Eiichi YAMAGUCHI and Takashi NISHIOKA

NTT Basic Research Laboratories, Musashino-shi, Tokyo 180

(Received January 24, 1990; accepted for publication March 7, 1990)

A gigantic neutron burst of  $(1-2) \times 10^6$  n/s has been detected from deuterated Pd plates with heterostructures set in a vacuum chamber. An explosive release of  $D_2$  gas, biaxial bending of all the samples, and excess heat evolution were also observed at the same time. It has been concluded that these phenomena are caused by the cooperative production of D accumulation layers at Pd surfaces due to controlled out-diffusion of D-atoms.

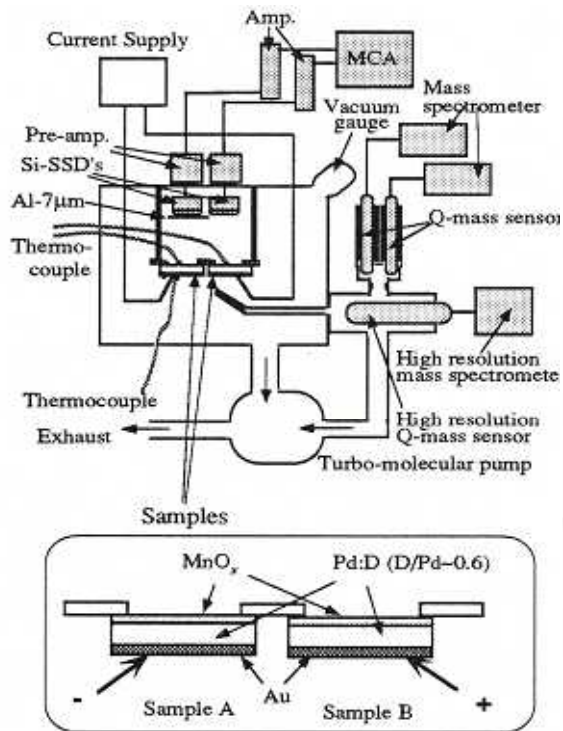
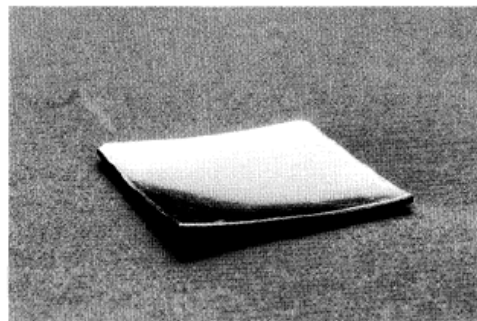
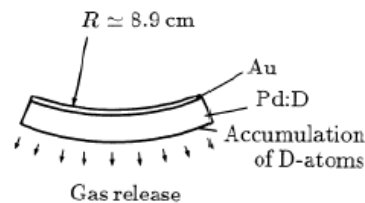


Fig. 1: Schematic diagram of the measuring apparatus.

Improved experiment

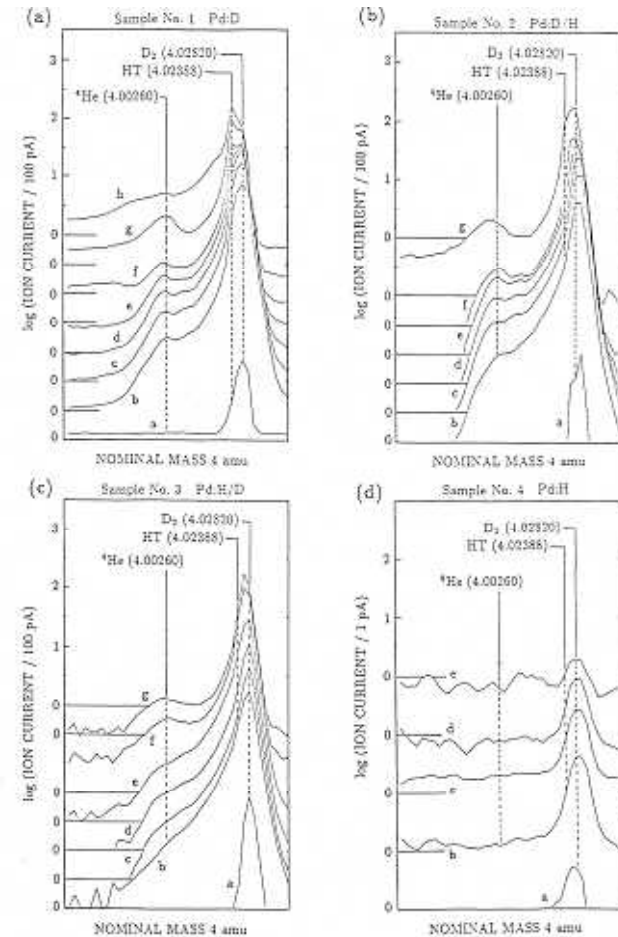


Fig. 3: The experimental results of mass spectroscopy at nominal mass 4 for released gases from (a) sample No. 1, (b) No. 2, (c) No. 3 and (d) No. 4, where each spectra from (a) to (h) were taken at every 72 min. for sample No. 1, 28 min. for No. 2 and 3, and 55 min. for No. 4.

2nd period: 1994 - 1998

# 1994 – 1998

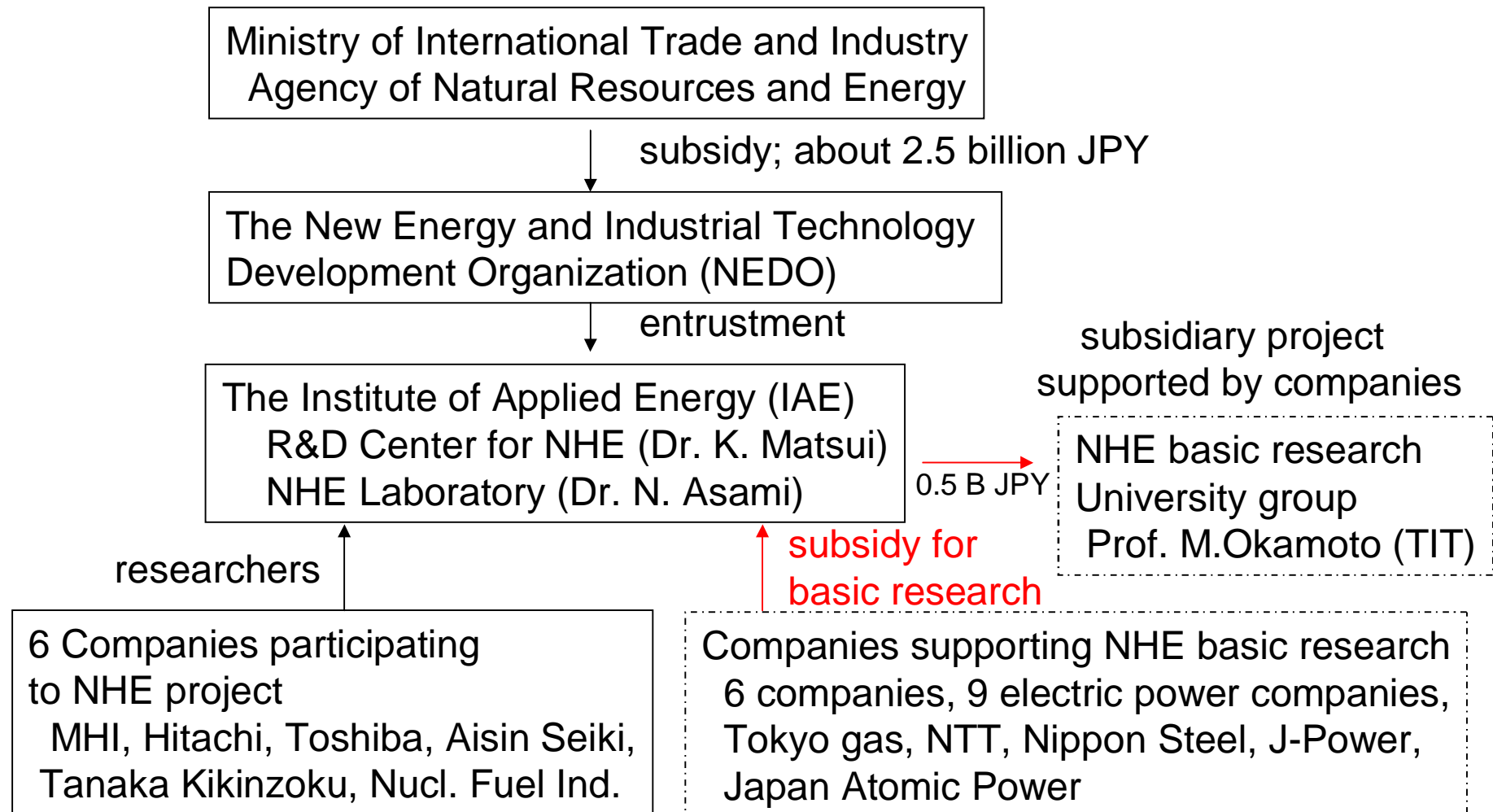
## period of the NHE project

- 1993.11 New Hydrogen Energy (NHE) project  
supported by Ministry of International Trade and Industry (MITI)
- 1994.2 NHE Symposium 94
- 1994.7 NHE Basic Research Project meeting
- 1995.7 NHE Basic Research Project meeting
- 1996.2 NHE Symposium 96
- 1996.7 NHE Basic Research Project meeting
- 1996.10 ICCF6 at Toya Lake
- 1998.6 NHE project terminated

2nd period: 1994 - 1998

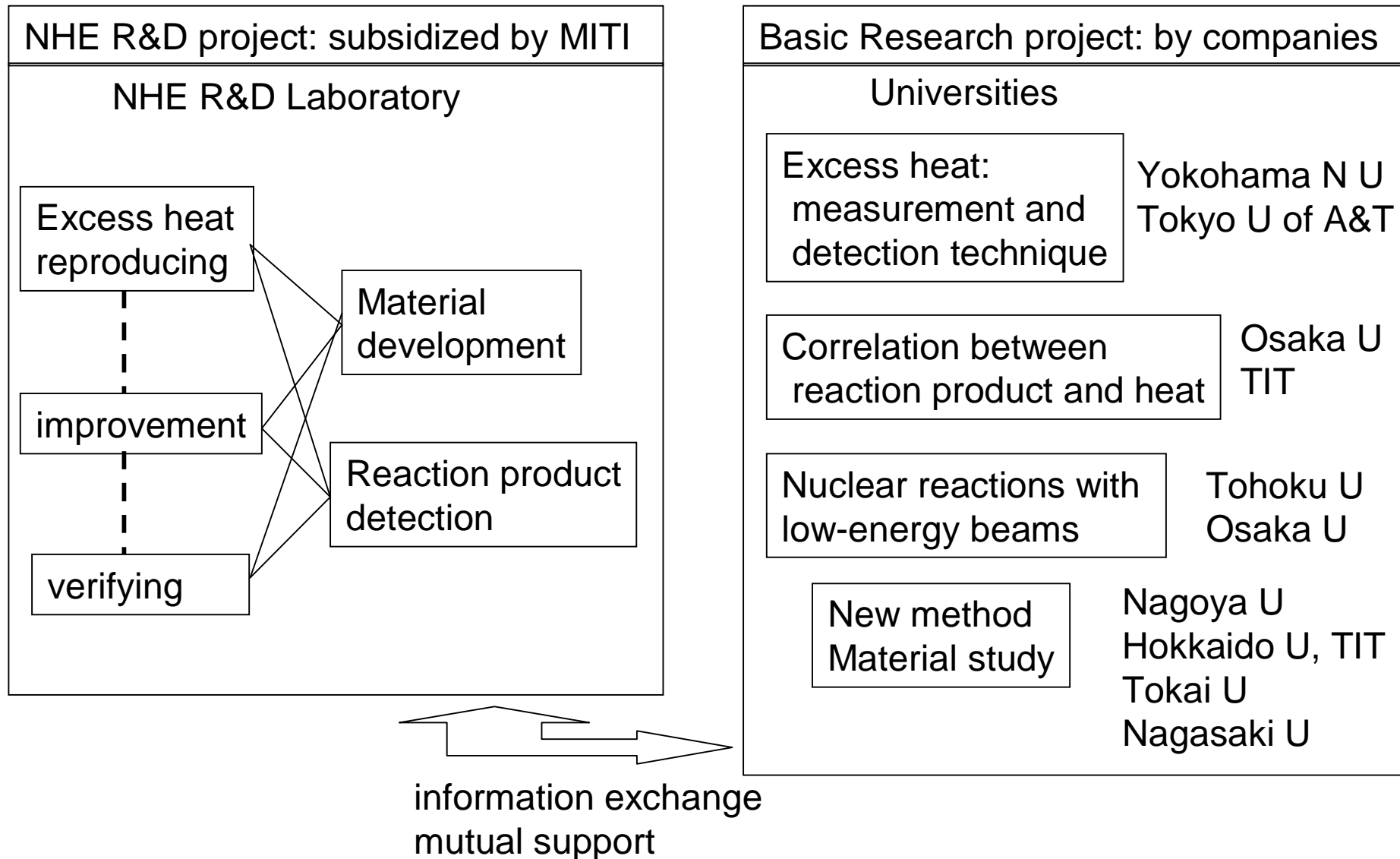
# New Hydrogen Energy Project 1993.11 – 1998.6

Organization



2nd period: 1994 - 1998

# NHE R&D and Basic Research



2nd period: 1994 - 1998

# Summary of the NHE R&D project

Main goal: reproducing and verifying the existence of excess heat generation, and nuclear products during electrolysis in Pd-LiOD system.

Conclusion of excess heat measurements:

- (1) No apparent excess heat was observed over instrumentation limits after about 500 of electrolysis experiments by some kinds of well-developed cells.
- (2) This means that we failed to verify the existence of excess heat at the level which was expected at the beginning of the project. We concluded that it is hard at present to utilize the “new hydrogen energy” for practical purposes with the present science and technology in this field.
- (3) Of course, we do not deny the possible existence of solid state nuclear reactions being unknown up to now and its possible trace amount of heat, however the phenomena still remains within a scope of fundamental research.

NHE R&D progress report: issued by NEDO from FY1993 to FY1997

Report on evaluation of the NHE project; issued by NEDO, 1998.6

2nd period: 1994 - 1998

# Characteristics of the second period

Start of the official project with reasonable amount of funds was great.  
Many researchers could proceed their studies around the core NHE project.

Research funds for the Basic Research played a key role to continue and develop high quality studies in various Universities.

Several private companies started their own experiments, in addition to the participation in the NHE R&D project. (IMURA, MHI, NTT, Toshiba, Honda,..)

Meetings were held almost annually; both university and industry researchers participated and discussed together.

International exchange was promoted by the NHE project: several researchers from USA, Russia, Italy, .. worked at NHE Lab and Universities.

NHE Basic research progress report: issued by IAE from FY1993 to FY1997

Grant-in-Aid for scientific research by Ministry of Education

Only one group obtained the grants.

Iwate U. (1994-95, 1996-97, Yamada G)

from the data base for Grant-in-Aid in Scientific Research

Important contribution: J. Kasagi (with A. Lipson), discovery of large screening

2nd period: 1994 - 1998

ICCF-7  
VANCOUVER  
The Best Event

ANOMALOUSLY ENHANCED  $D(d,p)T$  REACTION IN Pd AND PdO OBSERVED AT VERY LOW BOMBARDING ENERGIES

J. Kasagi, H. Yuki, T. Itoh, N. Kasajima, T. Ohtsuki and A. G. Lipson<sup>5</sup>  
*Laboratory of Nuclear Science, Tohoku University, Mikamine, Sendai 982, Japan*

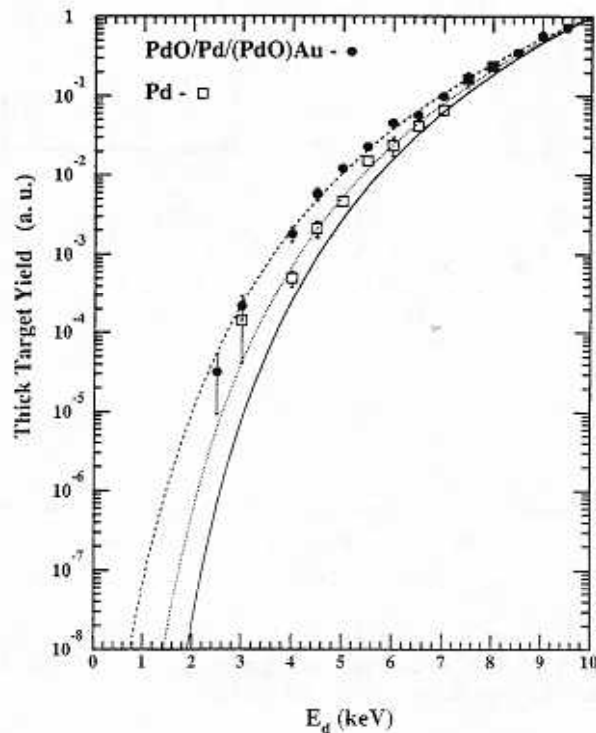


Fig. 2. Thick target yields of the  $D(d,p)T$  reactions in Pd (squares) and PdO (circles) against bombarding energy. The solid curve is a calculated one without any enhancement. The dotted and dashed curves are those with the screening potential  $U_e = 250$  and  $600$  eV, respectively.

JETP LETTERS

VOLUME 68, NUMBER 11

10 DEC. 1998

Anomalous enhancement of  $DD$  reaction in Pd and Au/Pd/PdO heterostructure targets under low-energy deuteron bombardment

H. Yuki, J. Kasagi, A. G. Lipson,\* T. Ohtsuki, T. Baba, and T. Noda  
*Laboratory of Nuclear Science, Tohoku University, Mikamine, Sendai 982, Japan*

B. F. Lyakhov  
*Institute of Physical Chemistry, Russian Academy of Sciences, 117915 Moscow, Russia*

N. Asami  
*Institute of Applied Energy, Minato-ku, Tokyo 105, Japan*

(Submitted 5 November 1998)  
*Pis'ma Zh. Eksp. Teor. Fiz.* 68, No. 11, 785–790 (10 December 1998)

Prof. T. Bressani remarked in summary of ICCF7

The first “miracle” of Cold Fusion observed in a typical Nuclear Physics Experiment.

It is a dramatic proof of the influence that condensed matter effects may have on nuclear observable.

3rd period: 1999 -

## 1999 – present (after the NHE)

Meetings: JCF annual meeting

organized by special committee in Atomic Energy Society of Japan  
workshop held at Laboratory of Nuclear Science

1999.3 JCF1 at Osaka U. (The 1st meeting of the Japan C-F Research Society)

2000.3 Workshop on Anomalous Nuclear Fusion Reactions  
(at Arata Hall in Osaka U., organized by Shibata and J. K.)

2000.9 Workshop on Change of nuclear lifetime in various conditions

2000.10 JCF2 at Hokkaido U.

2001.10 JCF3 at Yokohama National U.

2002.10 JCF4 at Iwate U.

2003.5 kickoff meeting

2003.7 meeting for permeation experiments

2003.10 meeting for beam experiments

2003.11 FUSION03 (Nucl. Phys. Int. Conf. organized by Takigawa and J.K.)  
two sessions for nuclear fusion reactions in matter

2003.12 JCF5 at Kobe U.

2004.3 Workshop on Low-energy nuclear reactions in various phases

2004.4 Special session in Annual Meeting of Atomic Energy Society of Japan  
Nuclear phenomena in condensed matter in the sub-keV energy region

2004.6 meeting for transmutation experiments

2004.8 meeting for theory

2005.4 JCF6 at TIT

2005.8 meeting for permeation experiment and recent topics

2005.11 ICCF12 at Yokohama

2006.4 JCF7 at Kagoshima U.

2007.11 JCF8 at Doshisha U.

3rd period: 1999 -

## Characteristics of the third period

JCF (Japan C-F Research) Society was organized by Prof. A. Takahashi.  
JCF annual meeting has been held continuously.

Research groups have met the funding problem after the NHE project over.  
A few groups have been active in this field.

Active groups at present: Tohoku U. (Kasagi, LNS and Fukuhara, IMR),  
Iwate U.(Yamada, Narita) , Kobe U.(Kitamura),  
Hokkaido U.(Mizuno), TIT (Numata),  
MHI(Iwamura), Toyota Lab.(Hioki), ....

Grant-in-Aid for scientific research by Ministry of Education

Two groups have obtained the grants.

Iwate U. (1999-2000, 2002-03, 2004-05, Yamada G)

Tohoku U. (2002-03, 2004-06, 2007-10, Kasagi G)

from the data base for Grant-in-Aid in Scientific Research

Important contribution: Y. Iwamura, Transmutation process

### 3rd period: 1999 -

Jpn. J. Appl. Phys. Vol. 41 (2002) pp. 4642-4650  
 Part 1, No. 7A, July 2002  
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#### Elemental Analysis of Pd Complexes: Effects of D<sub>2</sub> Gas Permeation

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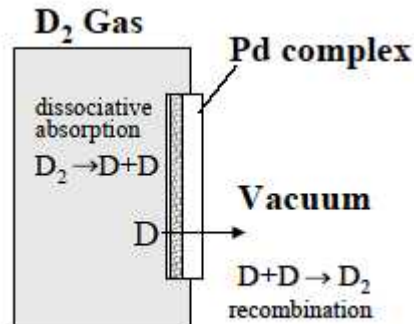
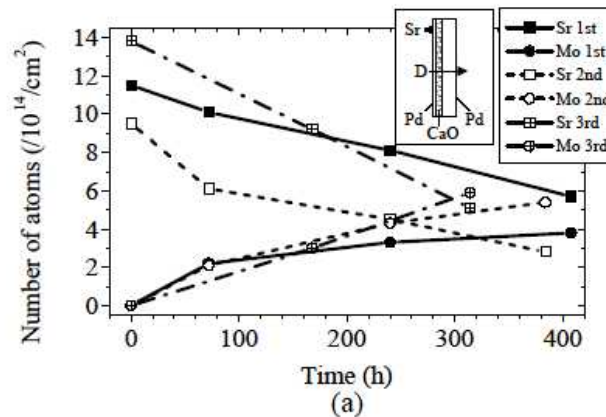
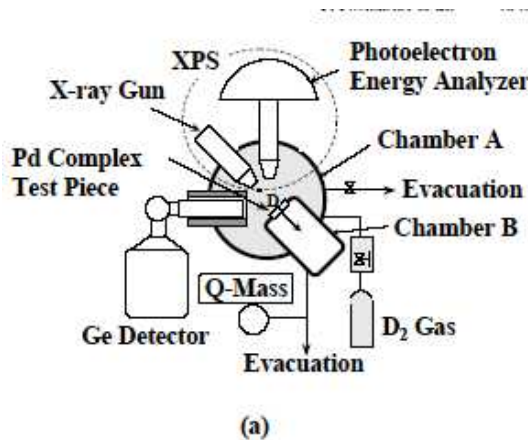
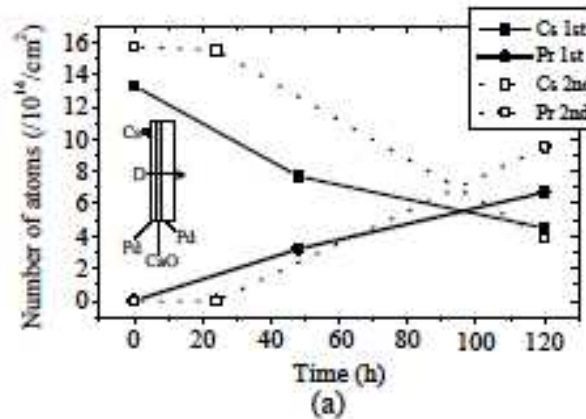
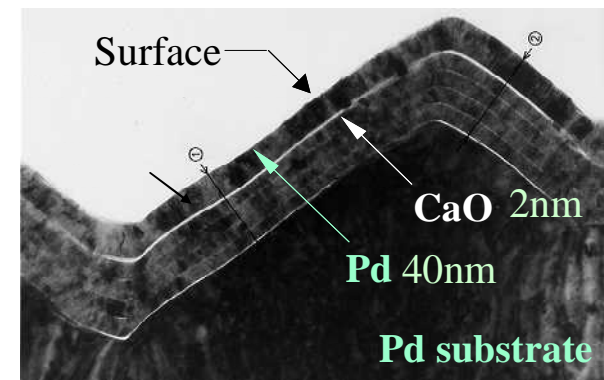


Fig. 1. D<sub>2</sub> gas permeation through the Pd complex.



ICCF10 News Flash  
 by Dr. T. Chubb;

Probably the most important of the results were those concerned with a unique form of nuclear transmutation reported a year ago by Iwamura et al. of Mitsubishi Heavy Industries.



# For further development of CMNS

As seen, Japanese researchers have contributed a lot for “cold fusion” study in these 19 years. However, the present situation is rather pessimistic for the future.

Problems of research in this field in Japan

Research funding: no big project has been accepted after NHE

only small funding but for a few groups

i.e., not admitted as one of the scientific research fields in Japan

Decrease of active researchers: retirement and a few students

In Japan, “cold fusion” research field might disappear within a few years:

Hokkaido U., Tohoku U., Yokohama N. U., ....

Try hard;

to get convincing evidence showing nuclear origin.

to apply to various organizations for research funding.

to plan a research project with larger amounts, including other subjects.

Condensed Matter Nuclear Science: much broader concept than cold fusion

Connection of the nuclear degree with the condensed matter degree

nuclear reaction

nuclear decay

nuclear excitons