

The Launch of a New Plan on Condensed Matter Nuclear Science at Tohoku University

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³ HYDROGEN ENGINEERING APPLICATION & DEVELOPMENT COMPANY, JAPAN

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1. Background

Tohoku University

Prof. Kasagi

; Fundamental Research on CMNR (Screening etc..)

Mitsubishi Heavy Industries, Ltd.

Iwamura, Itoh, Tsugura

; Deuterium Permeation Transmutation Experiments

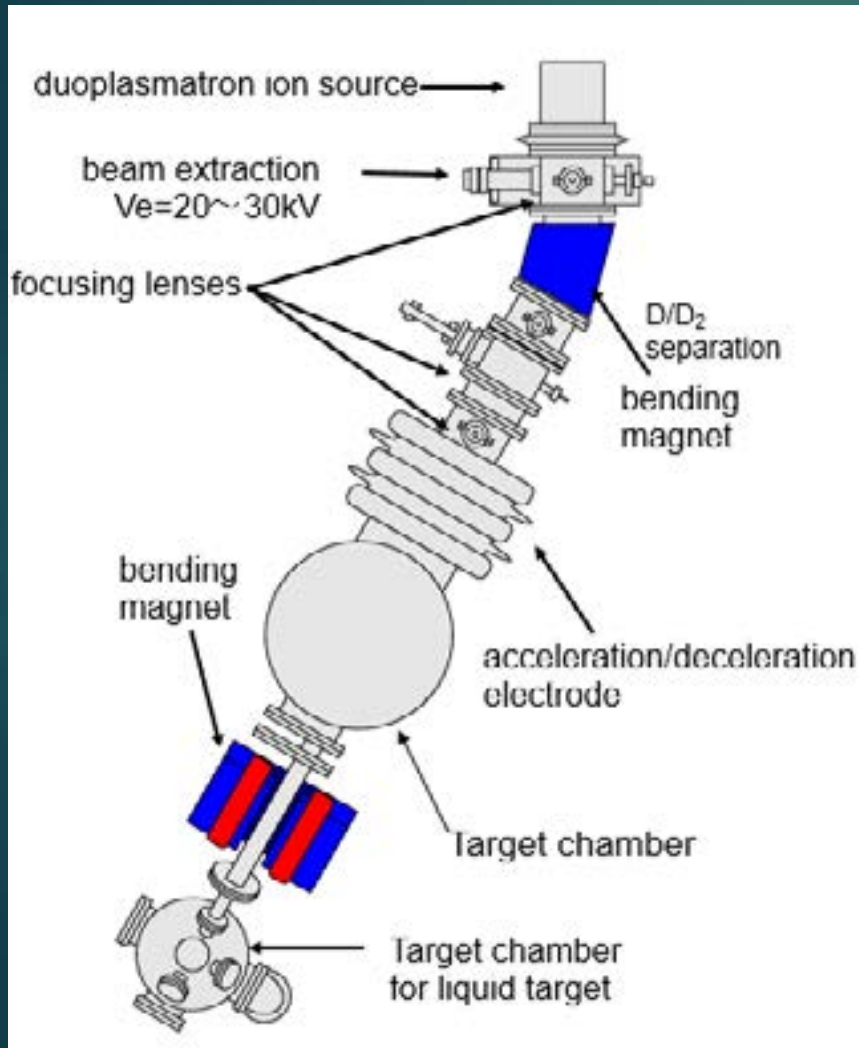
Clean Planet Inc.

Yoshino, Hattori, Igari

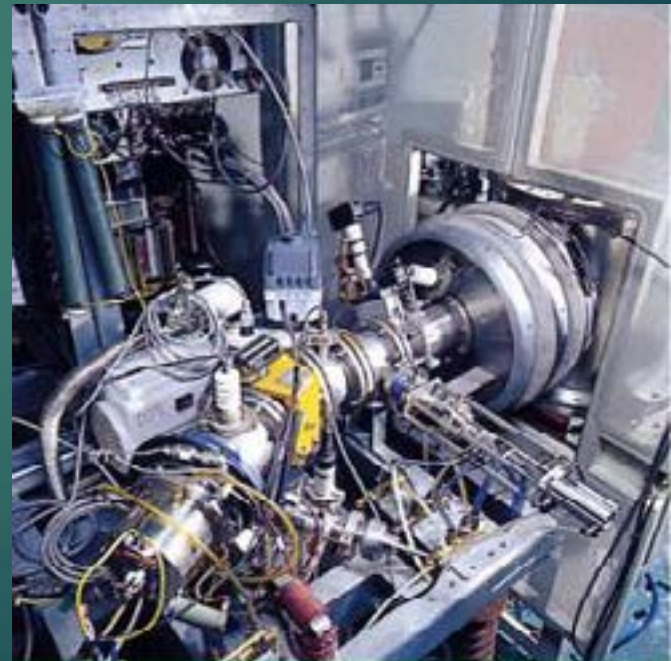
; Excess Heat Experiments with Dr. Mizuno

1-1 Tohoku University (1)

Low-energy deuteron generator at Tohoku Univ.

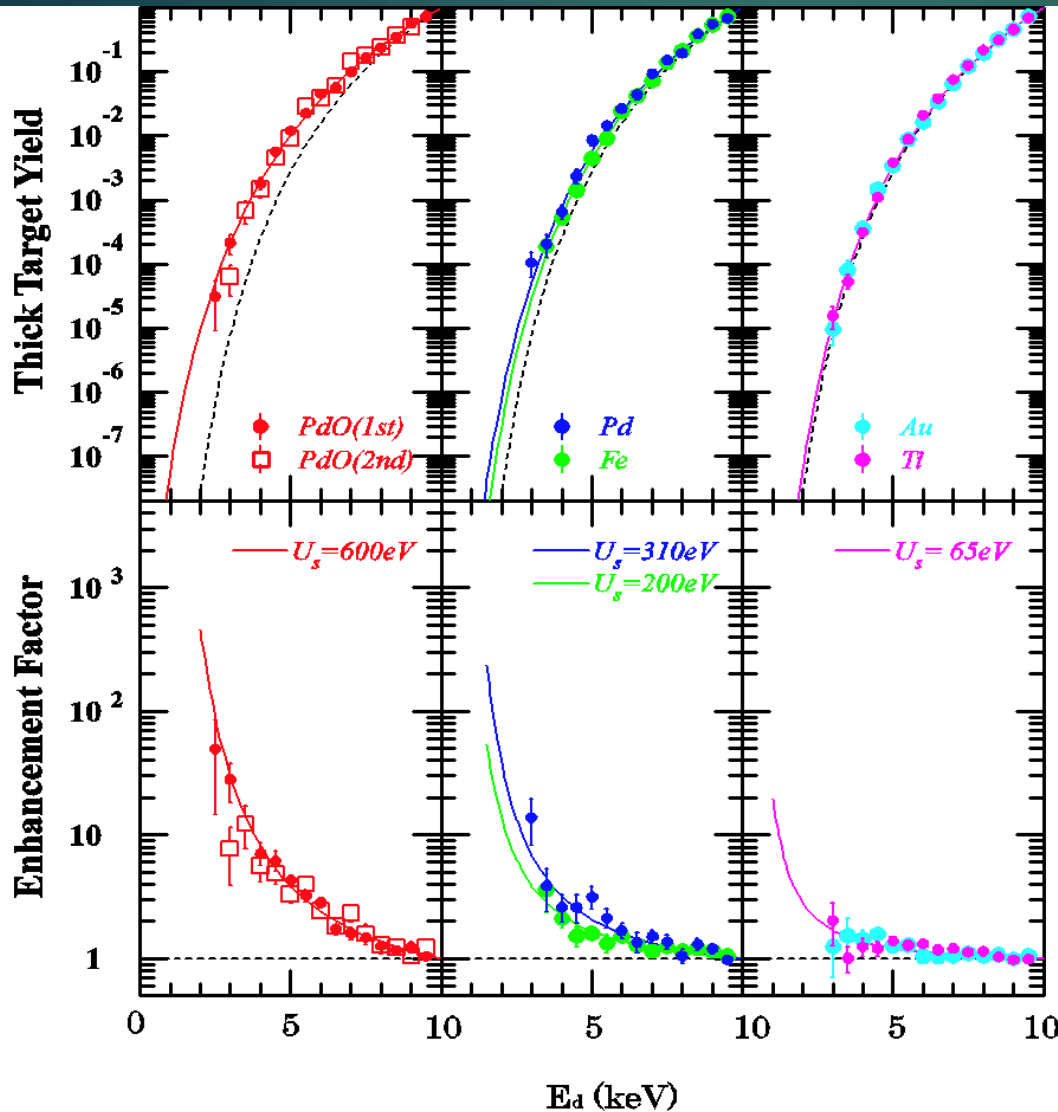


- $E_d = 2 \sim 100 \text{ keV}$
25 ~ 100 keV; acceleration mode
2 ~ 25 keV ; deceleration mode
- I_d up to 500 μA



1-1 Tohoku University (2)

Anomalously enhanced DD reaction in metal



Reaction rates at 2.5 keV
 $R(\text{in PdO}) \sim 100 \times R(\text{standard})$
 $R(\text{in Pd, Fe}) \sim 10 \times R(\text{standard})$
 $R(\text{in Ti, Au}) \sim 2R(\text{standard})$

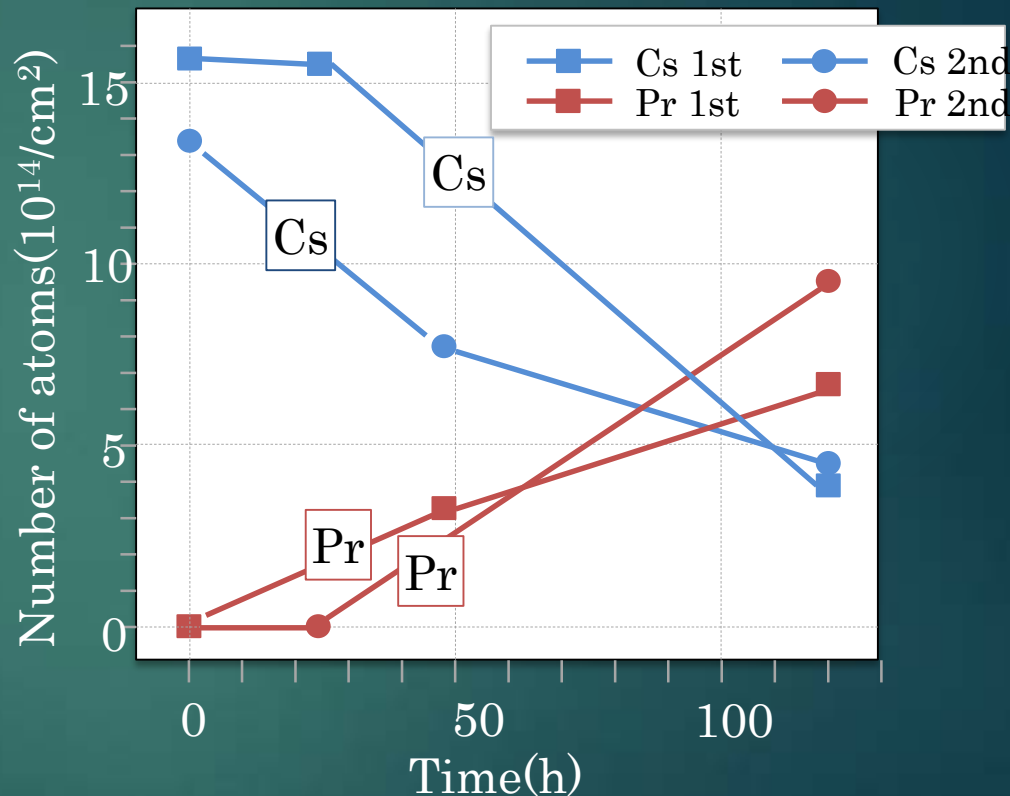
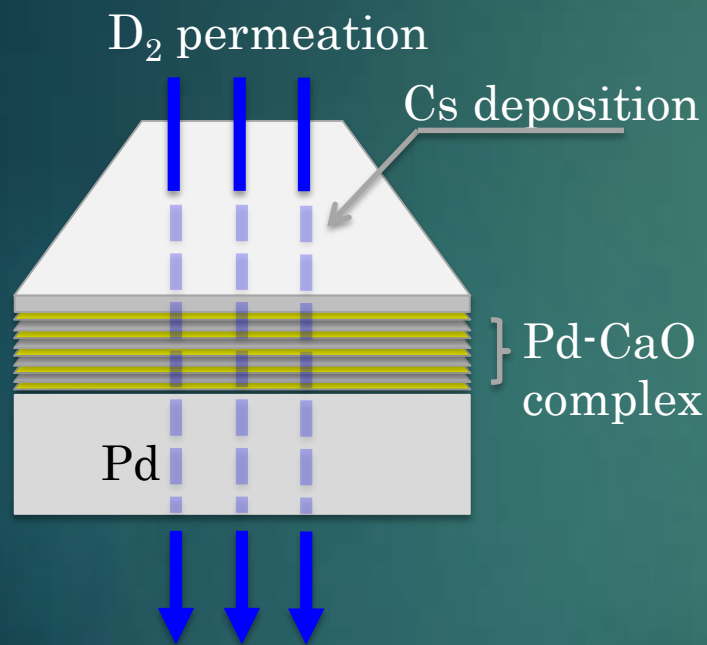
$R(\text{standard})$: thick target yield

**Large screening potential energy
Partly due to electrons, but not understood clearly;
need other origin**

Yuki et al., JETP Lett. 68 (1998) 823; Kasagi et al., J. Phys. Soc. Jpn. 71 (2002) 2881

1-2 Mitsubishi Heavy Industries (1)

Deuterium Permeation Transmutation Experiments

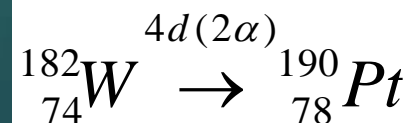
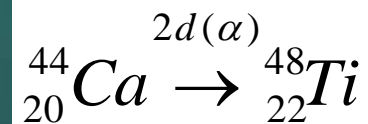
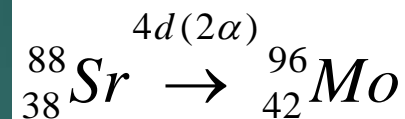
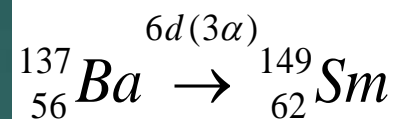
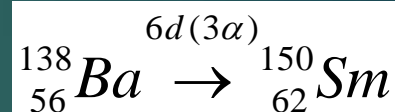
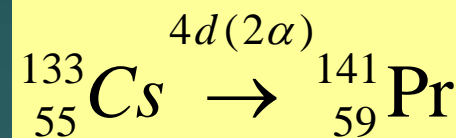


Y. Iwamura, M.Sakano and T.Itoh, "Elemental Analysis of Pd Complexes: Effects of D₂ Gas Permeation", *Japanese Journal of Applied Physics*, Vol.41, p.4642-4650, 2002.

1-2 Mitsubishi Heavy Industries (2)

Summary of Transmutation Reactions observed so far

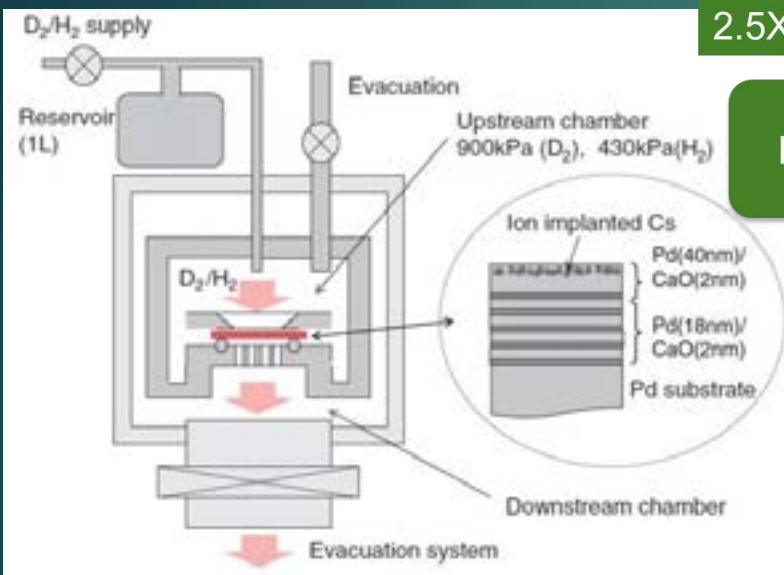
	IA	IIA	IIIA	IVA	VA	VIA	VIIA	VIIIA	IB	IIB	IIIB	IVB	VB	VIB	VIB	0		
1	H															He		
2	Li	Be											B	C	N	O	F	Ne
3	Na	Mg											Al	Si	P	S	Cl	Ar
4	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
5	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
6	Cs	Ba	La	Hf	Ta	W	Re	Os	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn	
7	Fr	Ra	Ac															
	L	La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu		
	A	Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr		



- 1) Alkali metals; Electron Emitter
- 2) 2d, 4d, 6d; α capture reactions

1-2 Mitsubishi Heavy Industries(3)

Independent Reproduction Experiments by Toyota Central R&D Labs.



$2.5 \times 10^{12} / \text{cm}^2$

Pr

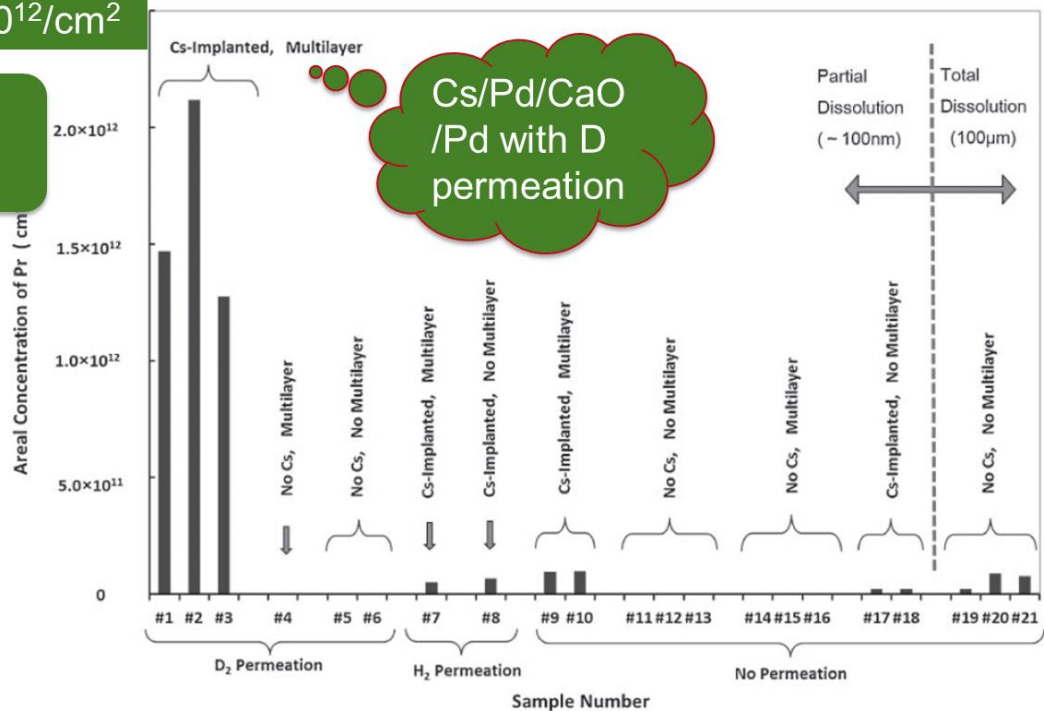
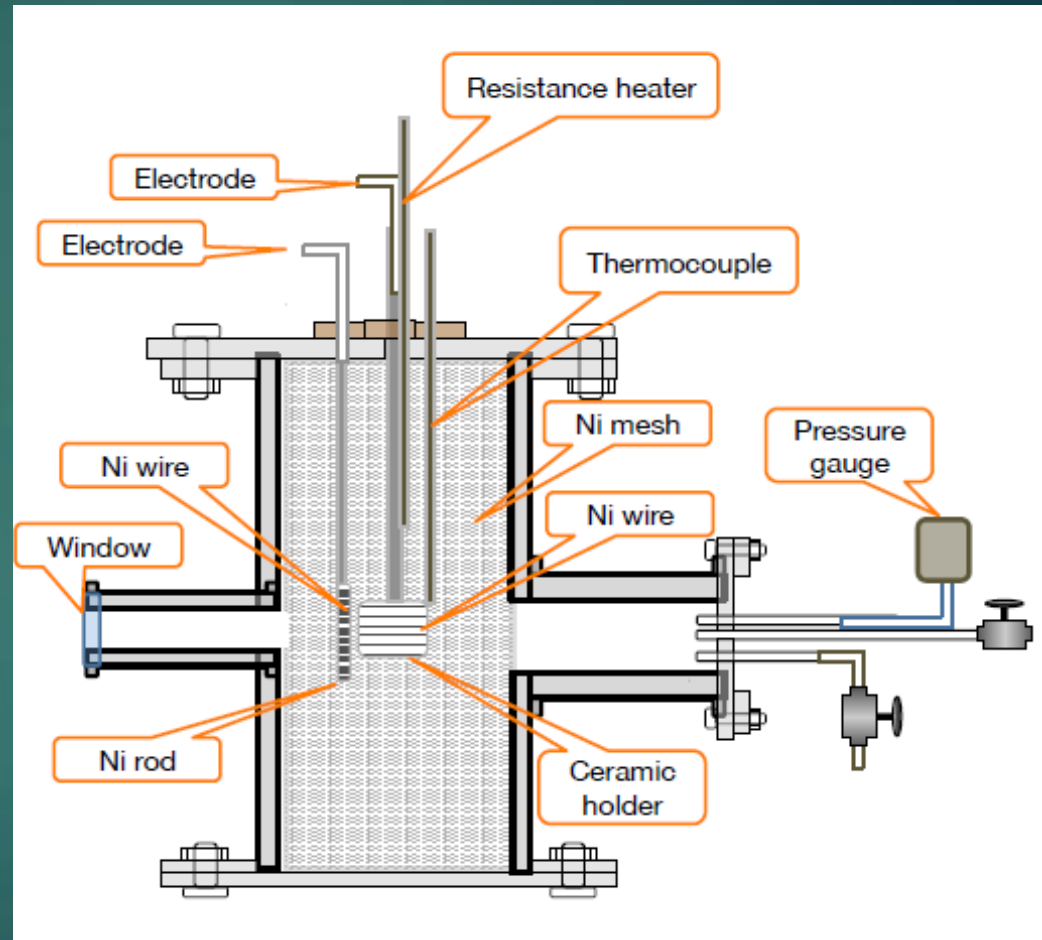
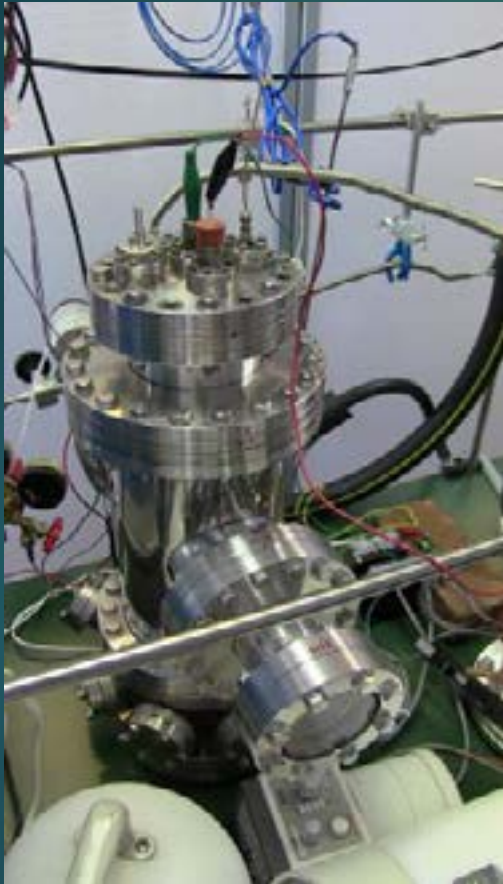


Fig. 7. Comparison of the amount of Pr detected by ICP-MS for the samples studied.

T. Hioki et.al, *Jpn. J. Appl. Phys.* **52**(2013) 107301

1-3 Clean Planet Inc.(1)

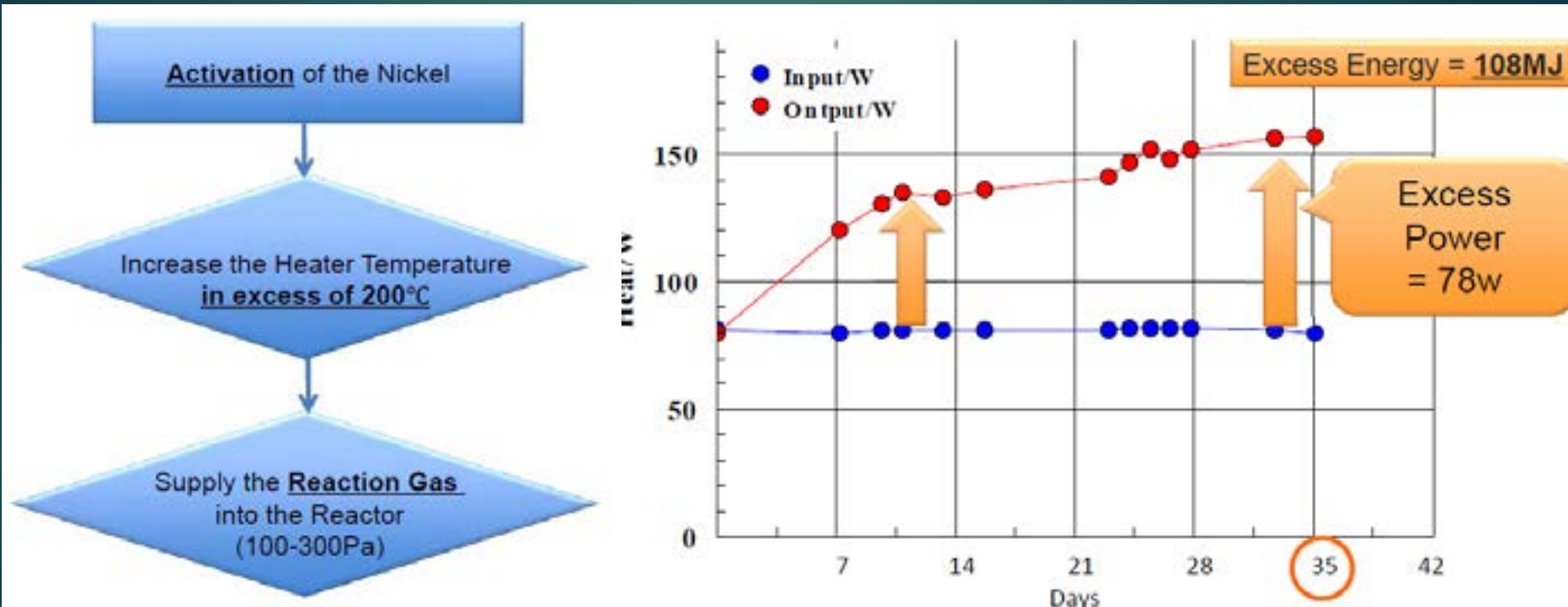
Experimental Set-up



Presented at 2014 CF/LANR Colloquium at MIT, March.21-23, 2014, Massachusetts Institute of Technology, Cambridge, MA, USA

1-3 Clean Planet Inc.(2)

Excess Heat Generation



Presented at 2014 CF/LANR Colloquium at MIT, March.21-23, 2014, Massachusetts Institute of Technology, Cambridge, MA, USA

2. Condensed Matter Nuclear Reaction Division (April 2015 ~)

It belongs to

**Research Center for
Electron Photon Science,
Tohoku University, Sendai,
Japan**



Research Center for Electron Photon Science

2-1 Purpose of the Division

- ▶ **1. Fundamental Research on Condensed Matter Nuclear Reaction (CMNR)**
 - ▶ Systematic Data on CMNR
 - ▶ Improve the reliability of Measurement of CMNR
- ▶ **2. Development of a New Energy Generation Method**
 - ▶ Most Probable Method for Energy Generation
 - ▶ Ascertain the Feasibility as a new energy source
- ▶ **3. Development of a New Nuclear Waste Decontamination Method**
 - ▶ Enhance the rate of Transmutation
 - ▶ Supported by the ImPACT R&D Program

2-2 Organization of the Division

Clean Planet Inc.

Develop and Promote Clean Energy Technologies

Hideki Yoshino,
Takehiko Itoh
Masanao Hattori

HEAD

Tadahiko Mizuno

Research Center for Electron Photon Science, Tohoku University

Condensed Matter Nuclear Reaction Division (2015-2018)

Jirohta Kasagi
Yasuhiro Iwamura
Hidetoshi Kikunaga
Takehiko Itoh
Hideki Yoshino

Nuclear Physics, Beam Physics/Accelerator Science, Radio-chemistry

Condensed Matter Nuclear Science Group
Jirohta Kasagi

Radio-chemistry Group
Hidetoshi Kikunaga

Jointly Participation

Mitsubishi Heavy Industries, Ltd.

ImPACT Project (2015-2018)
Reduction and Resource Recycle of High Level Radioactive Wastes with Nuclear Transmutation

2-3 Outline of Research Plan

	FY 2015	FY 2016	FY2017	FY2018
Excess Heat Generation	Seeking for the Most Probable Method for Energy Generation		Ascertainment the Feasibility as a new energy source	
Nuclear Transmutation	Transmutation of Stable Elements, NAA of Products	Transmutation of Radioactive Isotopes for Nuclear Waste Decontamination		

3. Concluding Remarks

- ▶ This is the first official research division created for condensed matter nuclear reaction (CMNR) and its application in Japan.
- ▶ At this division, we will obtain fundamental data on nuclear reaction in anomalous heat generation phenomena, as well as in nuclear transmutation phenomena.
- ▶ We hope to bring revolutionary changes to the World through the conceptual change of conventional nuclear reaction.

Backup Slides

ImPACT R&D Program

Reduction and Resource Recycle of High Level Radioactive Wastes with Nuclear Transmutation



PM: Reiko Fujita

To obtain nuclear reaction data for long-lived fission products, and to confirm the world's first nuclear reaction path for conversion to short lived nuclides or stable nuclides

- ▶ Project 1: Development of separation and recovery technologies
- ▶ Project 2: Obtained nuclear reaction data & **new nuclear reaction control method**
- ▶ Project 3: Reaction theory modeling and simulation
- ▶ Project 4: Evaluation of nuclear transmutation system and development of elemental technologies
- ▶ Project 5: Process concept for design



A Part of
this
project

Members of the Division

- ▶ Research Center for Electron Photon Science, Tohoku University, Japan
 - ▶ Jirohta Kasagi
 - ▶ Yasuhiro Iwamura
 - ▶ Hidetoshi Kikunaga
- ▶ Clean Planet Inc., Japan
 - ▶ Hideki Yoshino
 - ▶ Takehiko Itoh
 - ▶ Masanao Hattori
- ▶ HEAD, Japan
 - ▶ Tadahiko Mizuno