Comparison of AHE data between H2 and He runs for CNZ7rrr sample - English version

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Comparison of AHE data between H_2 and He runs for CNZ7rrr sample

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Abstract

JCF21-5 (2020/12/11) M. Hasegawa *et al.* (Technova Inc.)

Evaluation of anomalous heat effect (AHE) by the interaction of 3rd re-calcined nano-composite CNZ7 (Cu_1Ni_7/zirconia) sample[1,2] and H2-gas at ca. 300 degree C RC (reaction chamber) condition was studied by the comparison of same sample with H2-gas foreground and He-gas calibration runs. The sample was the third calcined CNZ7 sample, called CNZ7rrr (334 g), exclusively expecting relevant increase of integrated excess heat. AHE at elevated temperature was clearly measured with 36-59 W of excess thermal power level through the phase from the rise-up by heater on to 8 hours elapsed stage. Large increase (over 100 degree C cf. Helium run) of local temperatures was observed at saturated AHE power phase by the H_2-gas run with 235W heater power input. We also observed the increases of temperature at several points along the central line of RC. The most impressive time-point was of rapid increase after exceeding 300 degree C in the most effective condition zone near the W2 heater.

We make summary as: Comparison between H2 run and He run is effective to evaluate accurately the AHE excess thermal power, for different samples and in selected RC conditions; namely, heater input powers, heat capacity of RC (including test sample) and the situation of heat transfer from RC to outside. Another analysis was done for the increased temperatures of four RC points of RTD sensors with Helium run, to compare with data by H2 runs. From the engineering point of view, the more effective RC would be designed one with flat temperature distribution along the center line of RC, as much flat as possible. The comparison evaluation method of hydrogen run with helium run is effective not only for measuring the excess heat but also observing dynamic behavior of this kind of metal hydrogen energy along the temperature change.

Any negative effect of He gas for the sample in the RC was not observed till now, but detail examination should be confirmed from the several points, for example reliability and durability of sample, and any effect to the amount or the situation of the absorption and desorption of hydrogen into the sample.

要旨

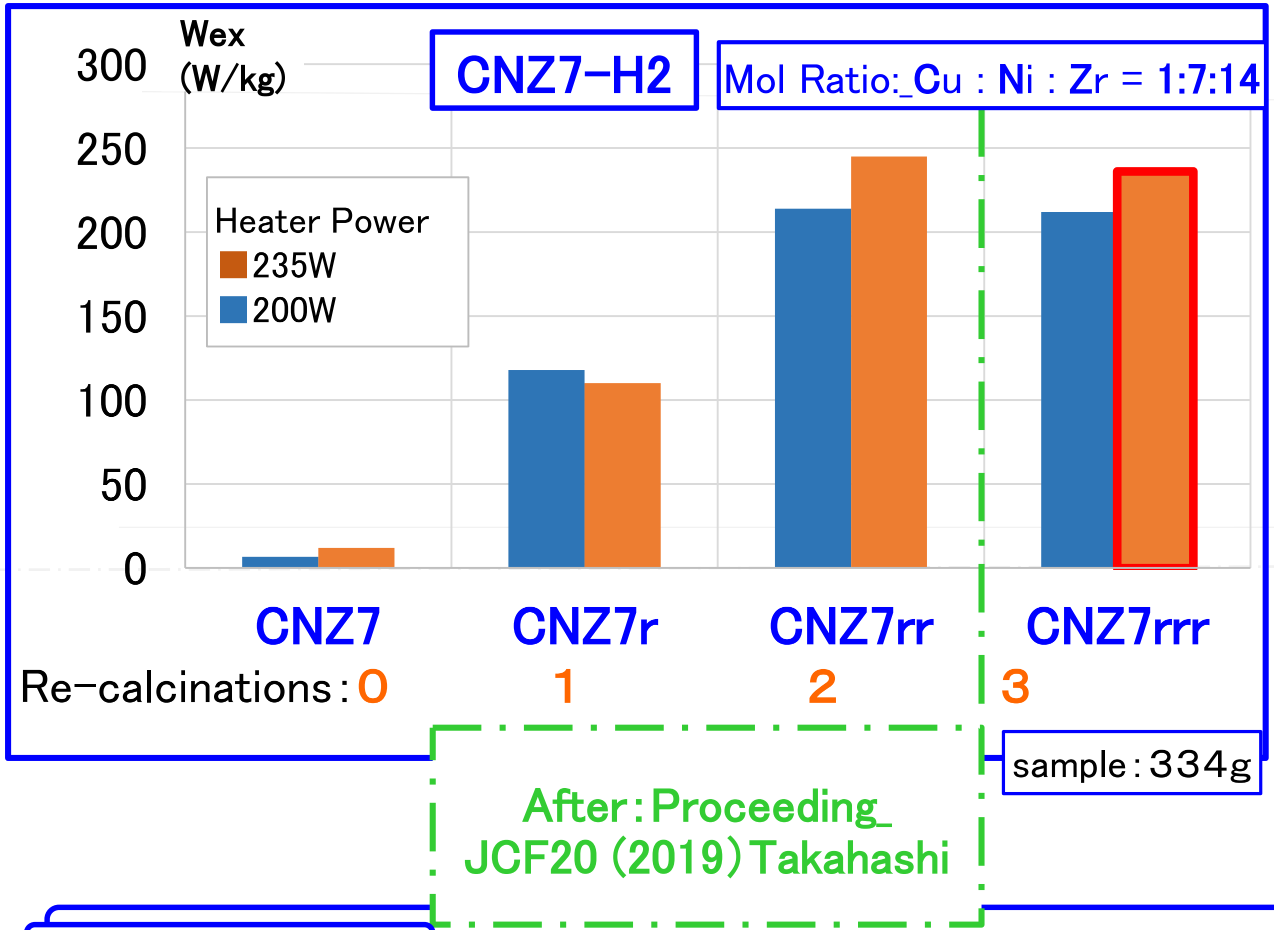
ナノ複合金属材料**CNZ7(Cu_1Ni_7/ジルコニア)** の3回焼成試料と水素による反応器(RC：reaction chamber)約300℃条件の相互作用の異常発熱効果(AHE : anomalous heat effect)の評価を、同一試料でヘリウム(He)ガスの校正試験と軽水素(H2)ガスの反応評価試験を比較実施した。

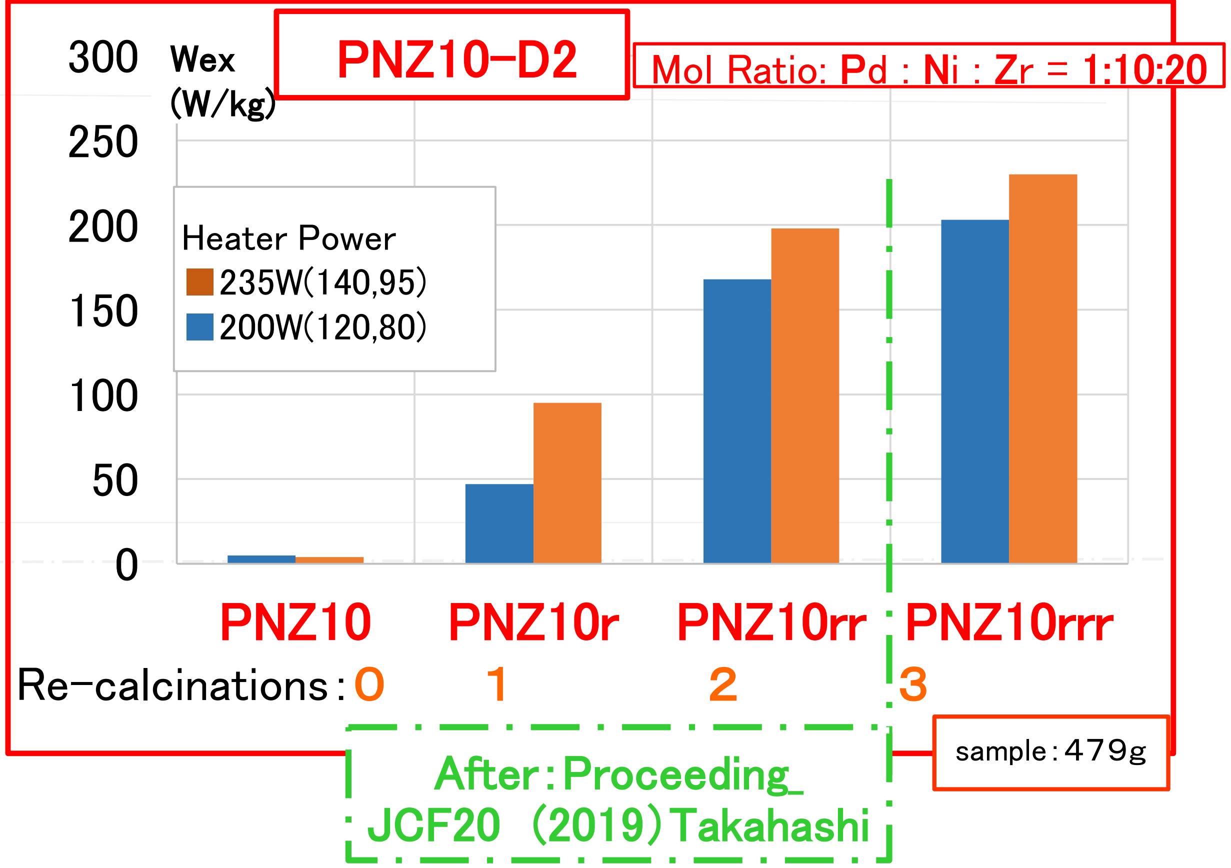
試料は**CNZ7を3回焼成したCNZ7rrr(334g)**で、**累積過剰熱の明らかな増加**が期待できる。温度上昇時のAHEは、加熱ヒータ入力後の立ち上げから8hの平衡段階までのフェーズを通して、**36－59Wの過剰熱出力レベル**が観測された。H2ガスで235Wのヒータ入力による試験におけるAHEの平衡出力フェーズで、**局所的な大幅な温度上昇(Heより約100℃以上の上昇)**が観測された。また、最も印象的な時点は、最も効果的位置のW2ヒータ近傍では、300℃を超えた時点で急上昇している点である。

以下がまとめである。H2とHeでの試験間の比較は、異なる試料や選択されたRC条件でのAHE過剰熱を正確に評価するのに有効である。その条件は、ヒータ入力、試料を含むRCの熱容量、RCから外部への熱伝達の状況である。他の解析として、試料4か所のRTD上昇温度を、HeとH2の試験データを比較している。技術的視点からの、より効果的なRCは、その中心軸に沿った温度分布ができる限り同一となる設計であろう。水素とヘリウムでの比較評価法は、この種類の金属水素エネルギーの過剰熱計測だけでなく、温度変化に沿った動的な振る舞いの観測においても有効である。

Heの反応器内試料へのマイナス効果は、現在、観測されていないが。詳細な検討が必要である。例えば試料の信頼性や耐久性、試料内への水素の吸蔵や離脱の状況への効果である。

1. Excess Thermal Power by MHE Reactions





Results of Wex

Wex increased by repeated re-calcinations (both for CNZ7 and PNZ10)

【Issue for Wex calibration】

Wex was estimated by comparing temperatures between MHE sample hydrogen runs and zirconia beads sample hydrogen runs, for same heater power

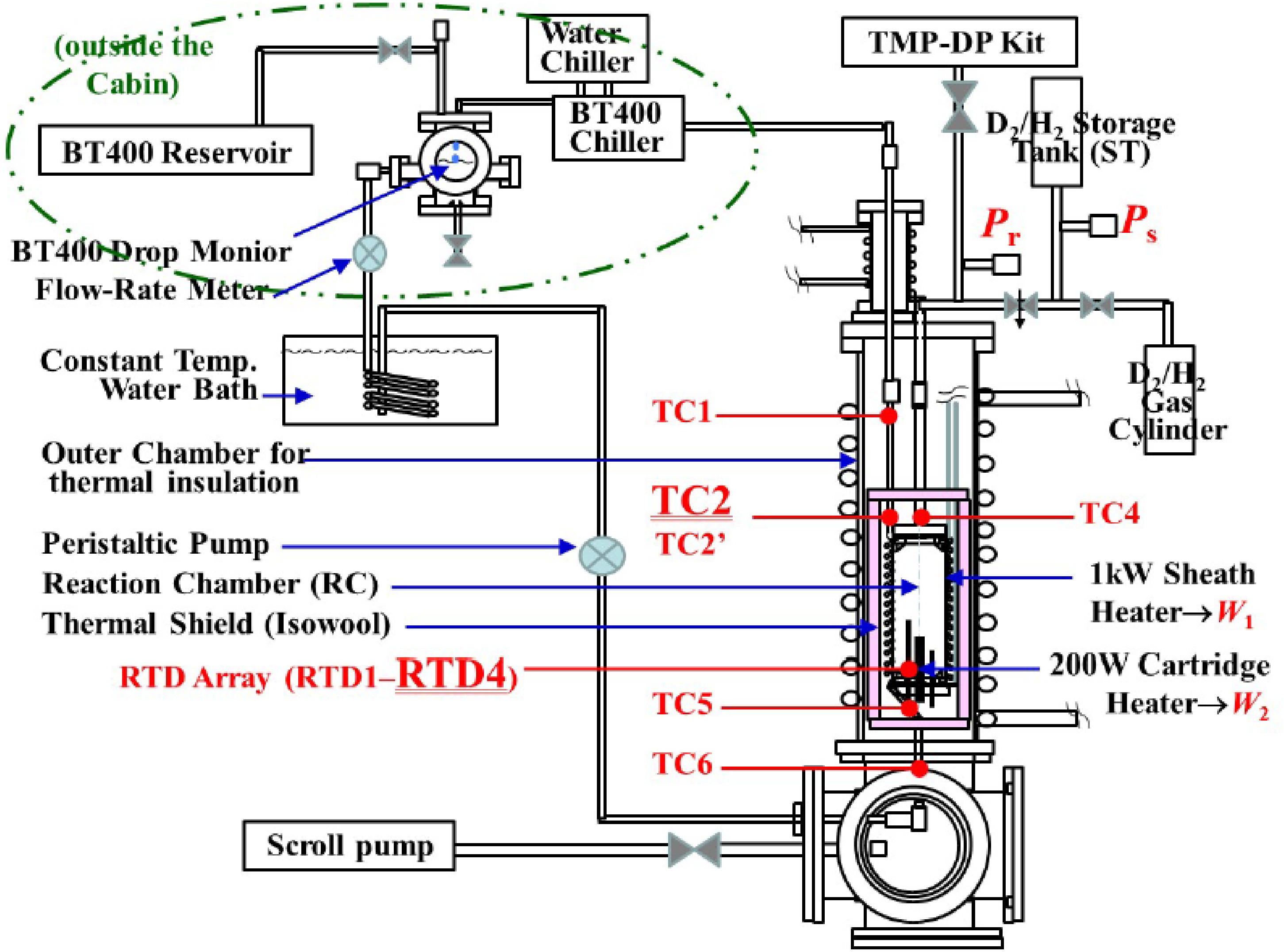
Desire by measurements and analysis side people

More clear method of Direct Feeling

◇MHE C-System at Technova MHE Kobe Laboratory

After:
Proceeding_
JCF20 (2019)
Takahashi

Schematic of the C_1 calorimetry apparatus of Kobe-U MHE System



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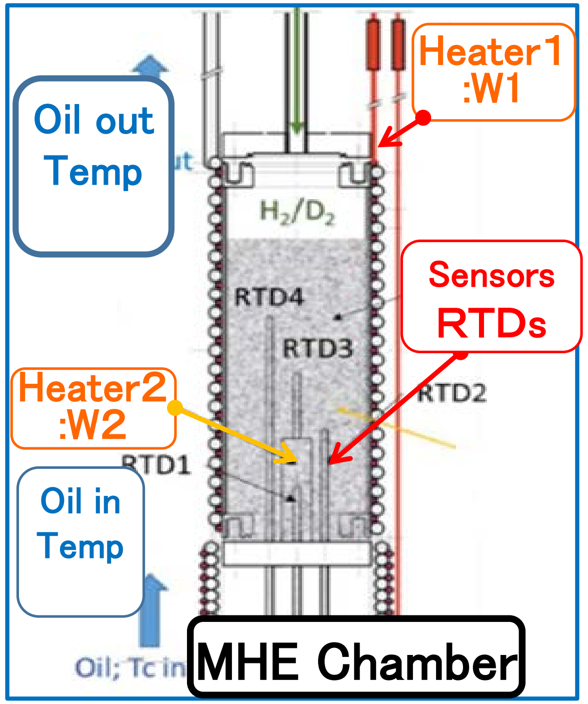
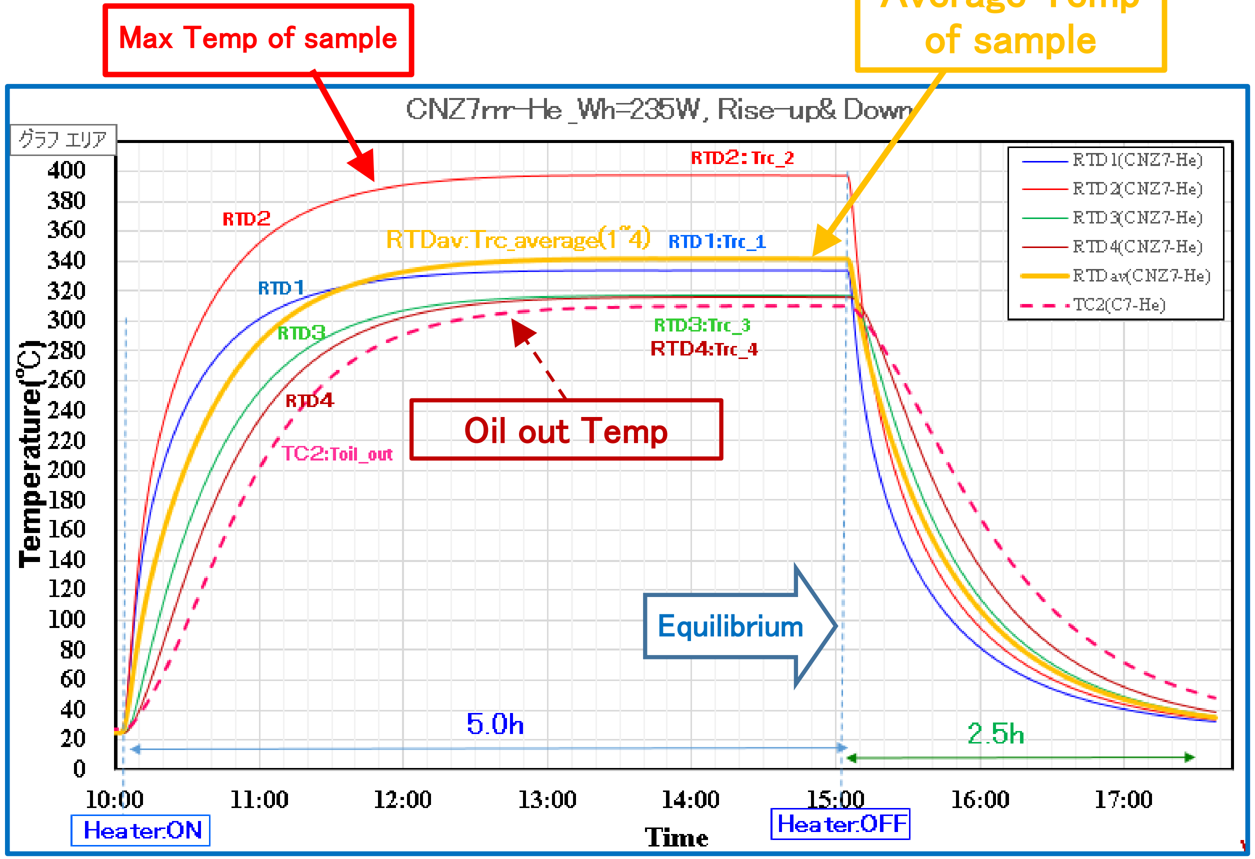
2. Calibration Methods of MHE Excess Power

◇Method 1) Oil mass flow calorimetry by ΔToil

Method 2) Average temperature of sample zone: ΔTrc_av

After: Proceeding_ JCF20 (2019) Takahashi





Method	Former	Present
Sample	Zr beads (φ1)	MHE powder
Gas	H2/D2	He

◇With same sample, compare temp between H and He runs
① Measure of direct impression of excess temperature
② Information of rise-up and time-dependent AHE data

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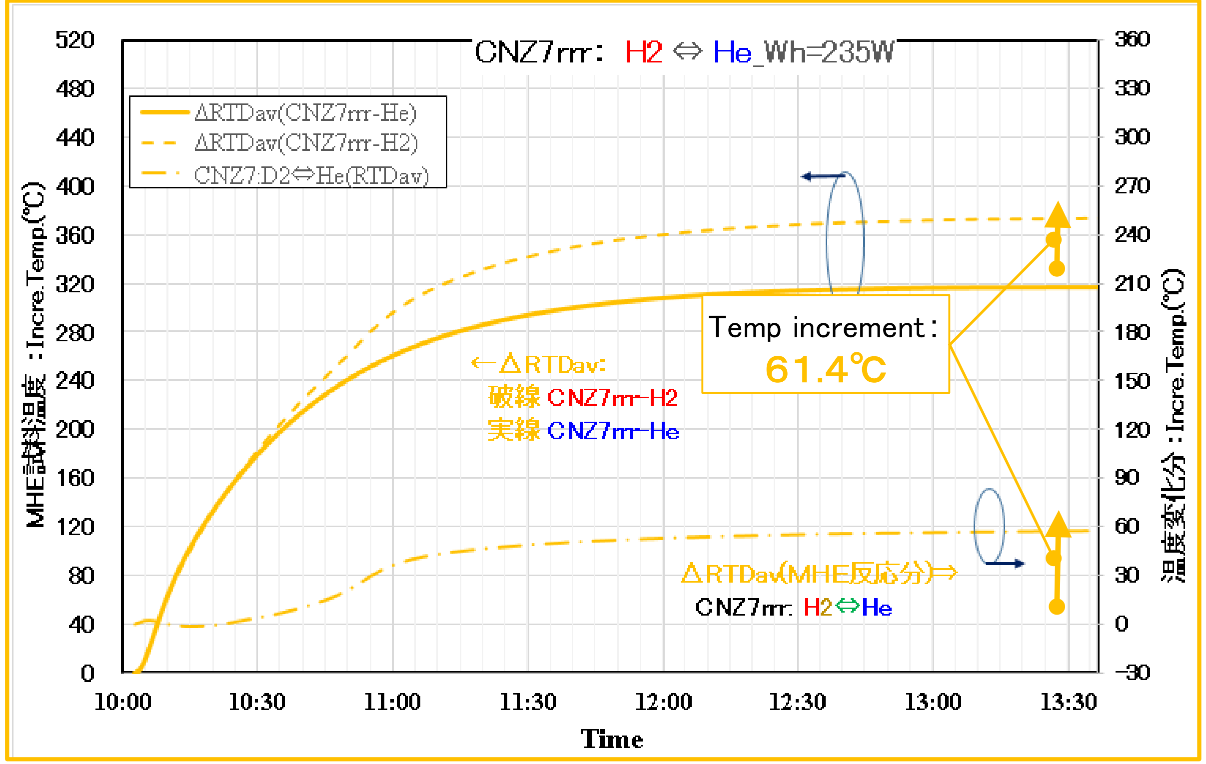
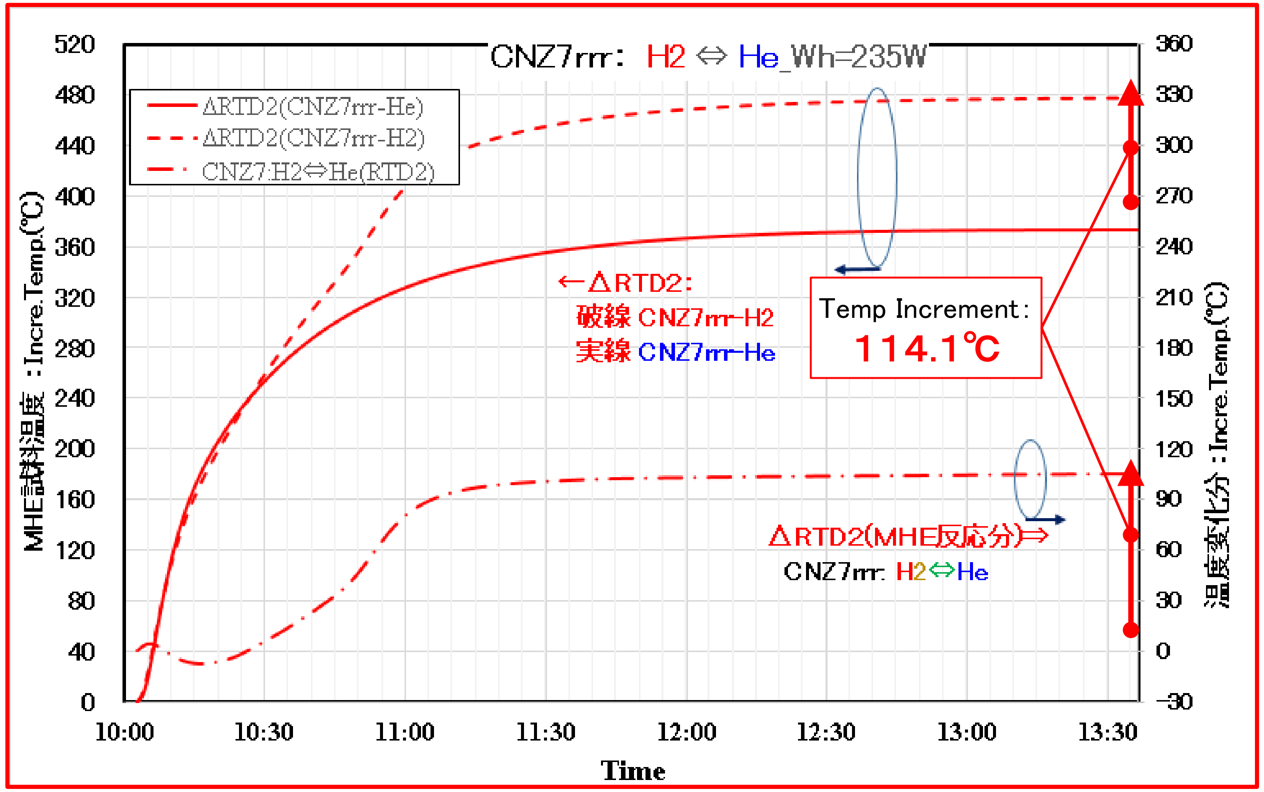
2. AHE Excess Heat for rise-up and saturated response

Broken line: H-gas
Solid line : He gas

2-1) Average Sample Temp in RC: RTDav



2-2) Max Temp of Sample: at RTD2



- More than 60℃ Increment of average sample temperature
- More than 100℃ increment of RTD2 temperature

◆ Merits of He Calibration Method:

1) Direct Impression of Excess Power by MHE AHE
2) Information of transient response

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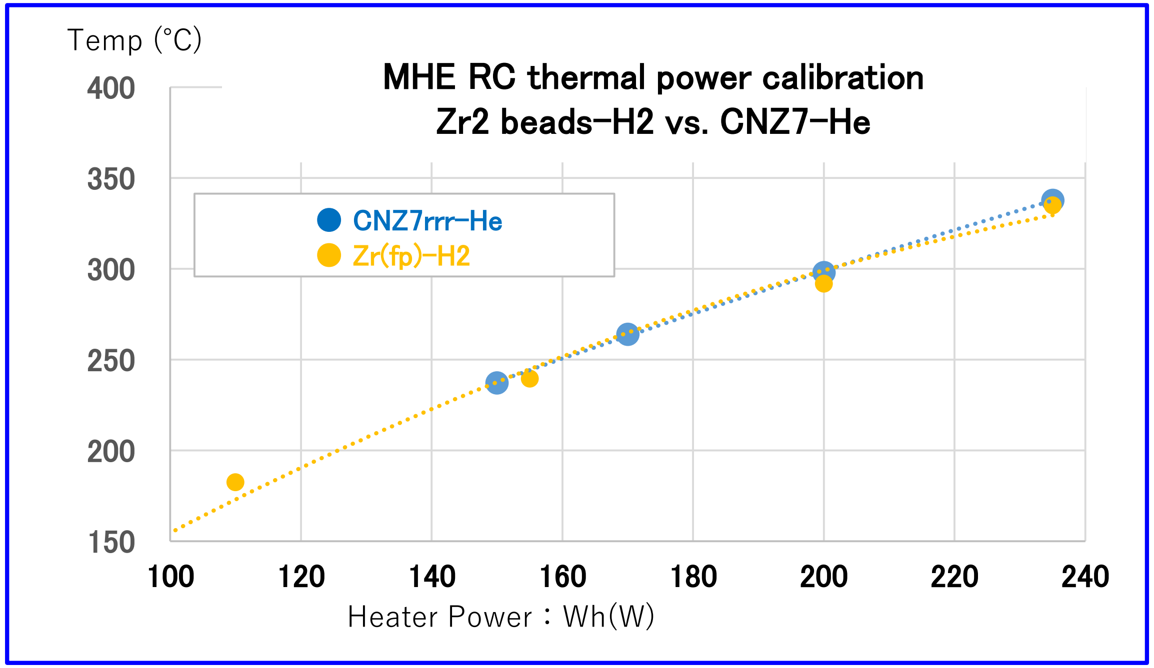
(1) MHE sample; atomic ratio and weight

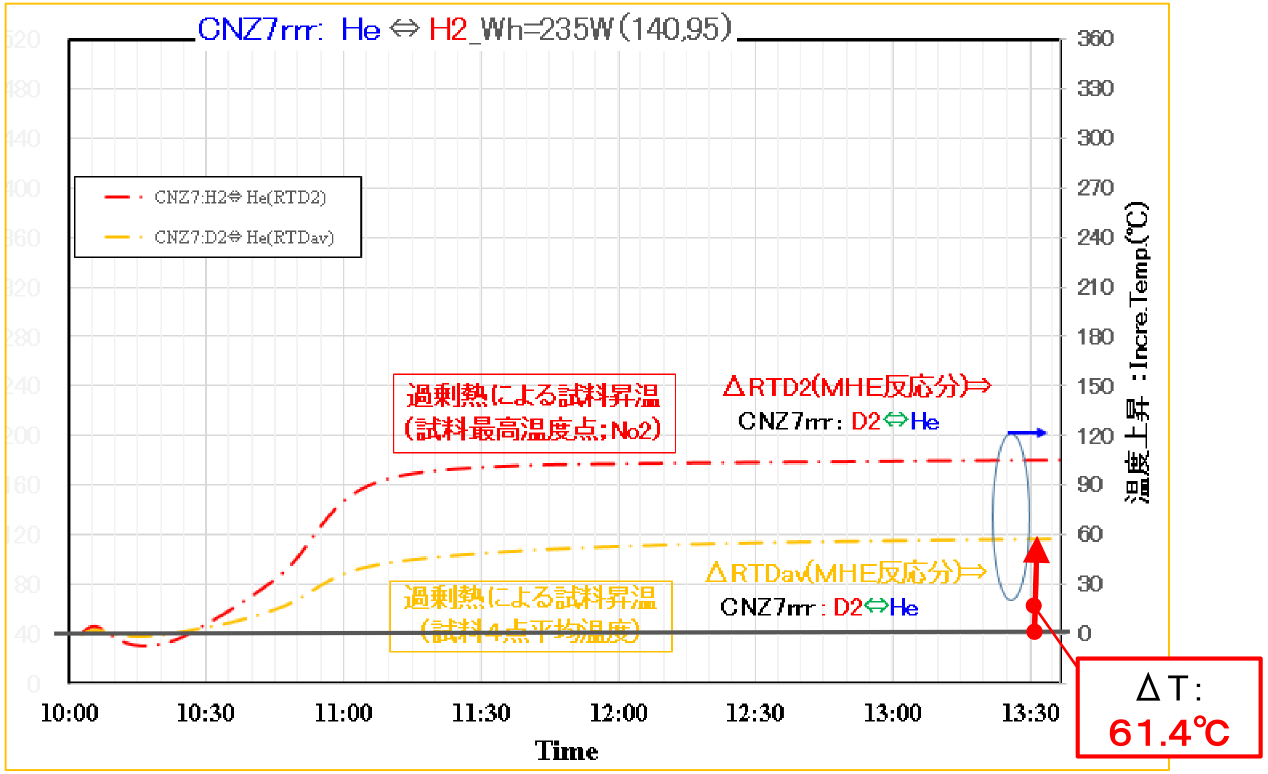
	元素比				重量比			
	Cu	Ni	Pd	Zr	Cu	Ni	Pd	Zr
CNZ7	1	7		14	3.6%	23.5%		72.9%
PNZ10		10	1	20		23.3%	4.2%	72.5%

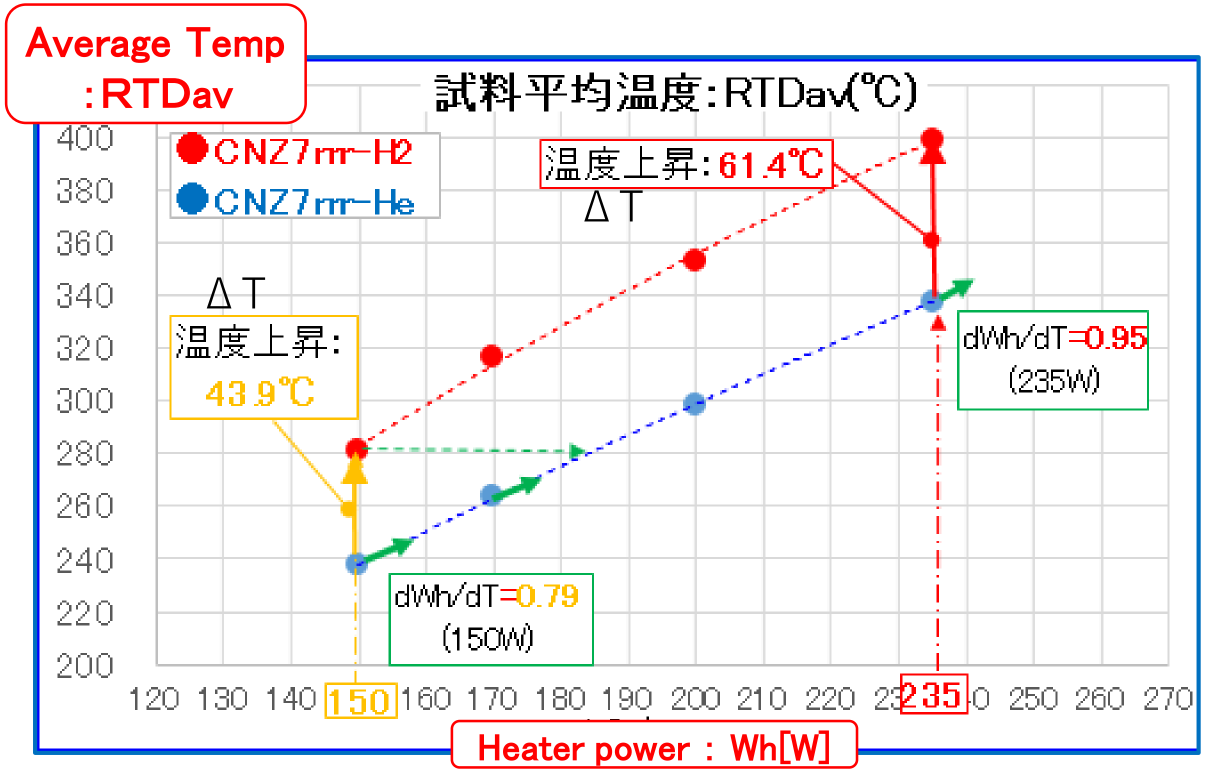
(2) ZrO2 beads-H2 calibration and CNZ7rrr-He calibration
(almost same curves: difference is small enough)

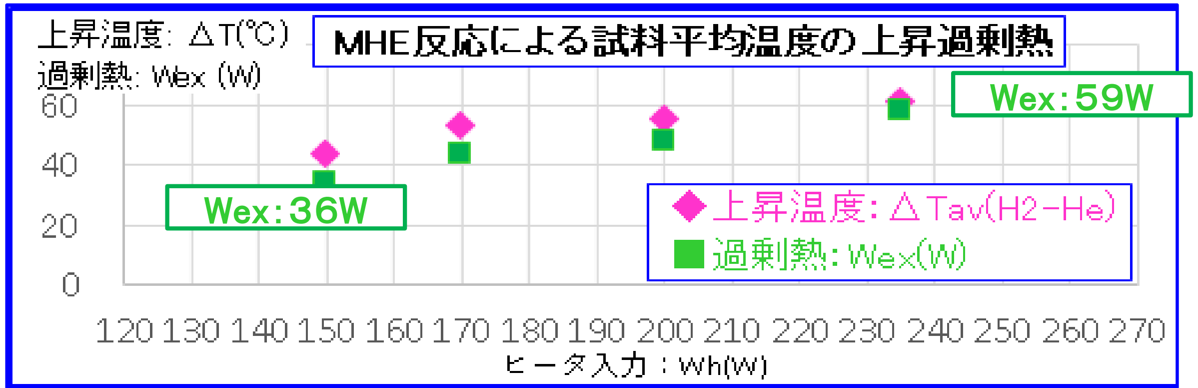


Method	Former	Present
Sample	Zr beads (ϕ1)	MHE powder
Gas	H2/D2	He

2. MHE AHE; Wex (Excess Power)
(3)Increment of Sample Temp and Wex







◆Results of Excess Thermal power by the He calibration method:
1) AHE excess power is observed in direct (intuitive) feeling.
2) For RC average temp (280～400℃), **we estimated 36～59W excess thermal power**

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3. Comparison of Heat calibration for MHE reaction

item	Previous method	Present method
sample	ZrO2 beads（ϕ1）	MHE powder
Gas	Hydrogen（H2 / D2）	Helium （ He ）
Merits	・ ・	・Calibration with same sample ・information of transient data (dynamics)
attention	・For transient data, adjust gas pressure to compensate difference in heat transfer efficiency. (using SQRT mass number)	・To bake out sufficiently absorbed hydrogen in MHE sample. (baking process under evacuation) ・Correction of heat transfer efficiency for transient data, using SQRT mass number

Summary:

Calibration of Excess Power by using same sample powder with comparison of H-gas run and He gas run
Is useful for observation of anomalous heat effect (AHE) by nano-Metal Hydrogen Energy (MHE).

【 Merits 】

1）For estimation of excess thermal power:

Observation in direct feeling for excess temperature increment by H-gas, cf. He gas.（Intuitive！）

For sample average temp (300～500℃で), **we observed 36－59W excess thermal power by AHE.**

2）Dynamic data for rise-up transient:

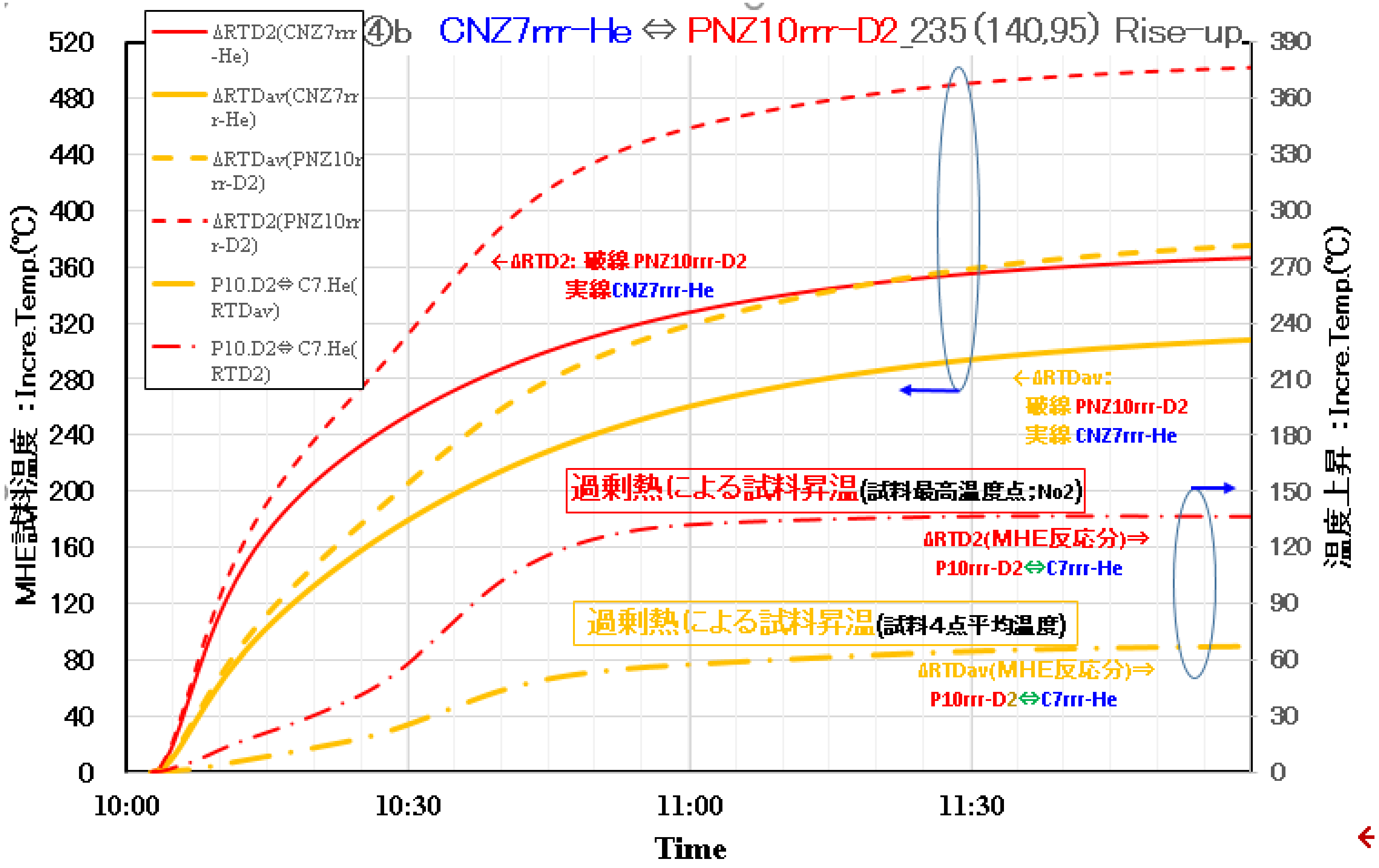
Temperature dependence of excess power is observable fro room temperature to elevated temperature as 500 deg C. Clear rise-up of Wex was seen in 200℃ ～330℃ region.

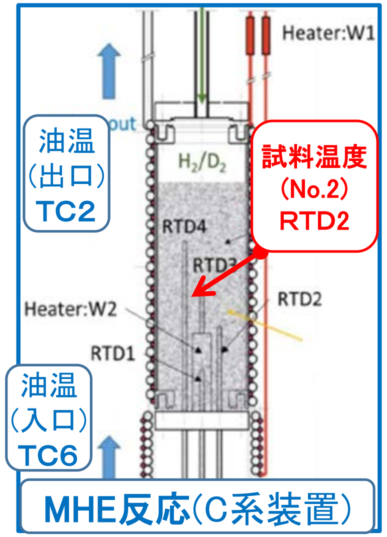
3）For experimental procedure:

Easy calibration of heat vs. temperature. （to shorten experimental time, save time for sample change and equipment parts change.

Appendix for Q&A
(not fully English translation)

(2) MHE Excess Heat Results (C-System)





Overview: MHE sample temp dynamics (①sample av. Temp. ②RTDNo2[2nd from bottom60mm])

- D2_MHE [Excess_for broken line] >> He_calibration [solid line]
- Especially clear effect for RTD2, from 250℃ region can be seen in steep temperature increment.

◇Nano Metal Composite（PNZ,CNZ）

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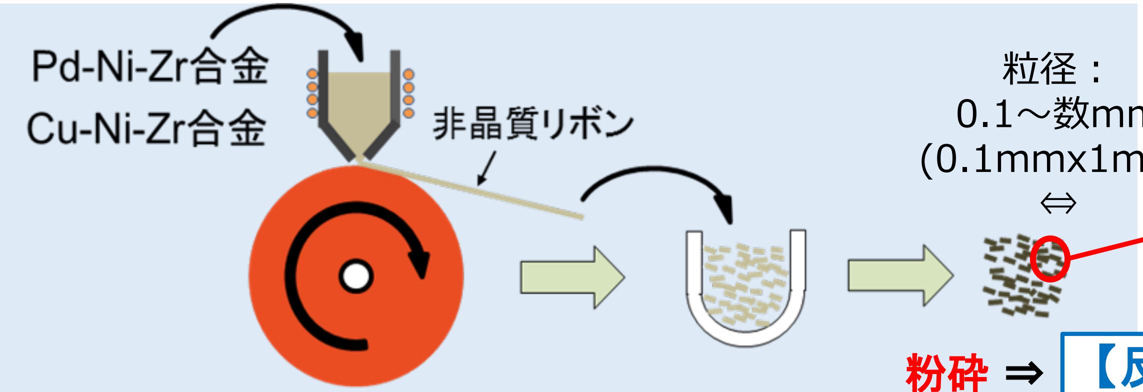
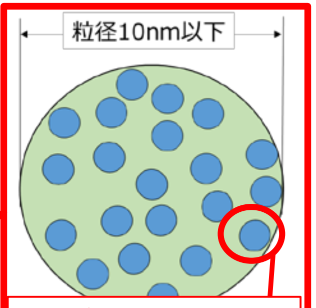
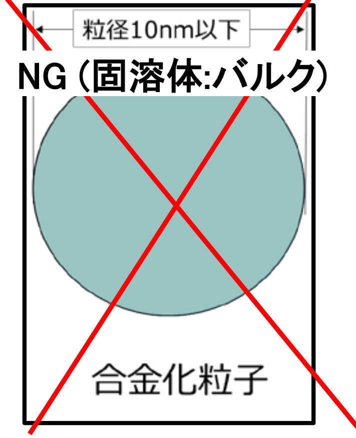






［工程］ アーク融解 ⇒ メルトスピニング　　熱処理(calcine) ⇒ 粉砕 ⇒ 試料 ⇒ 脱気 ⇒ abs/desorp ⇒ MHE reaction（⇒Evac）
(450℃x180H)

【反応器内】（焼成し繰り返し：r ⇒ rr⇒ rrr ）
Baking　Absorption/Desorption　AHE　（Baking）

【反応器外】（r ⇒rr ⇒rrr）
⇒焼成
Calcination

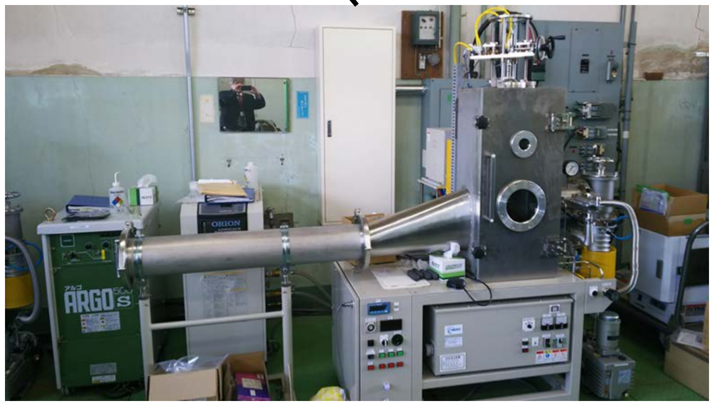
[state]　Alloy bottan ⇒ Amorphous ribbon　　Single nano Composite ⇒ ZrO2beads + MHE powder (set in RC)

Wex (reborn?)

Nano-islands Reaction sites increase !?!

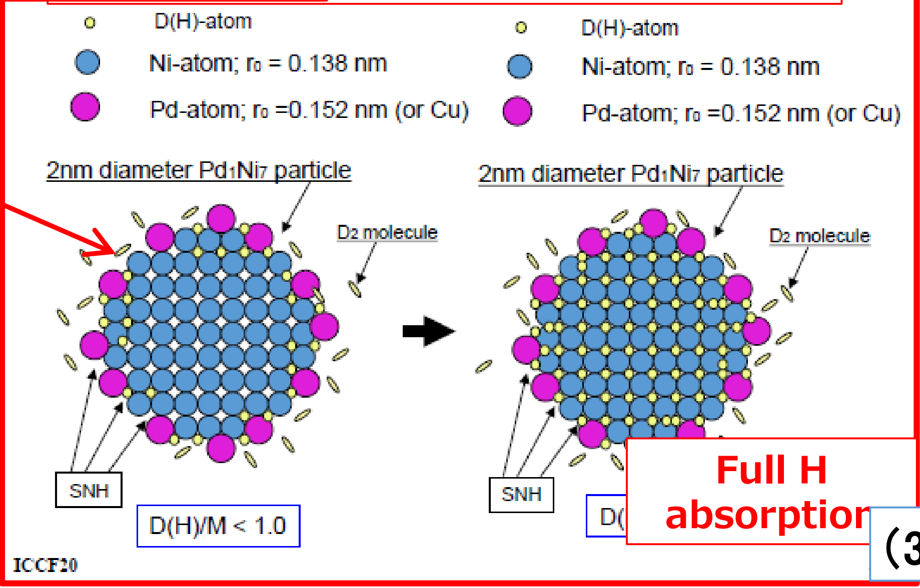
core/shell : ～several nm

Arc-melting



melt-spinning

MHE reaction sites at SNHs (incomplete shell)



Full H absorption

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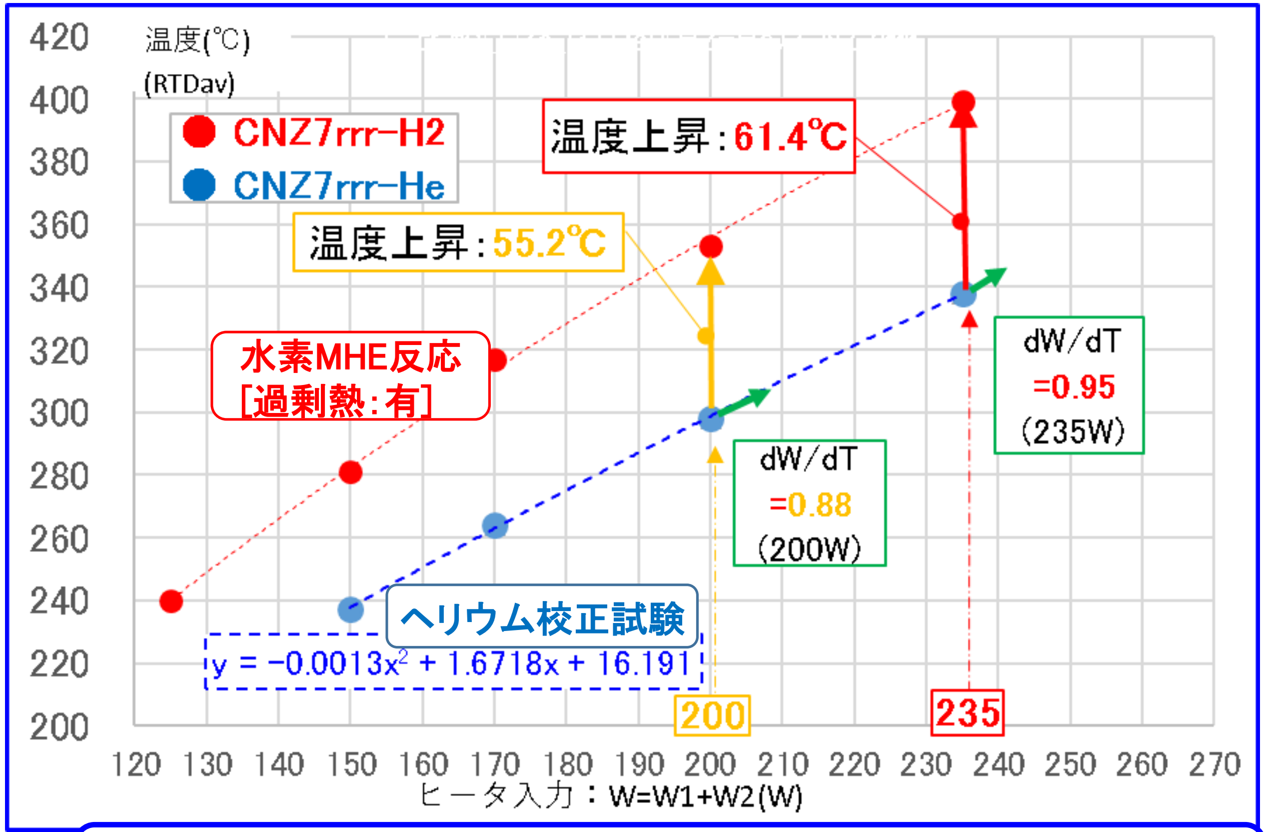
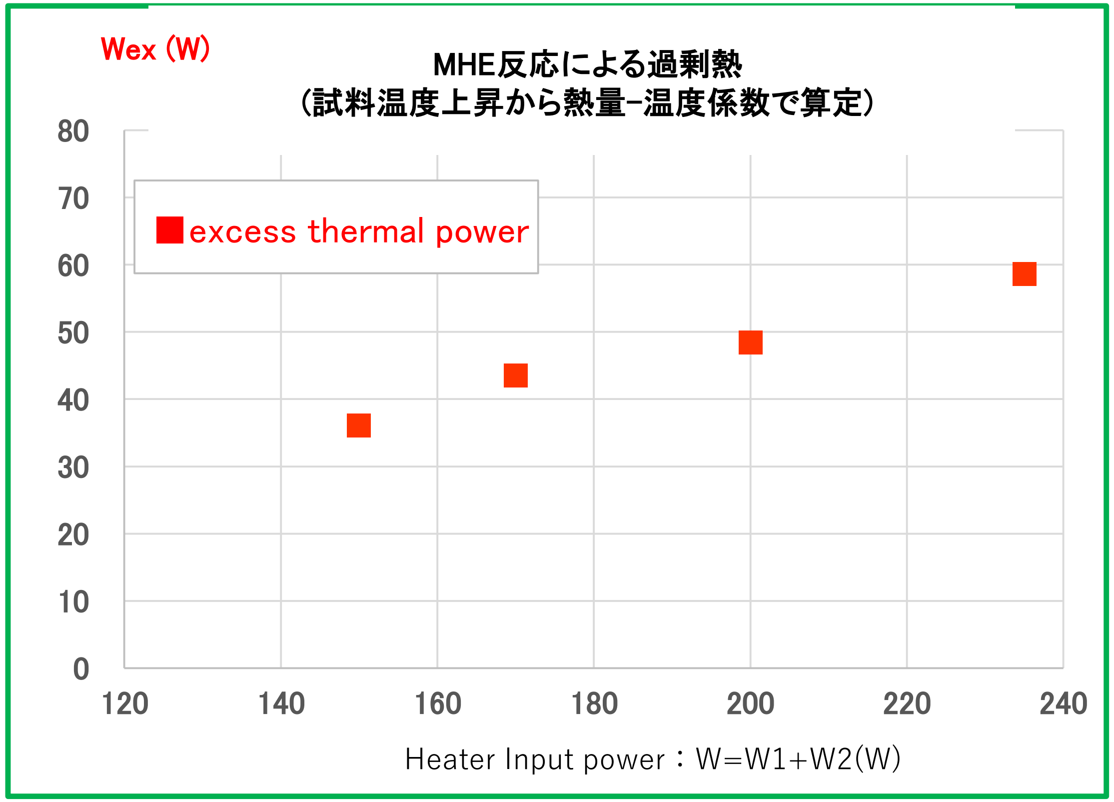


図①_ヒータ電気入力 と 試料平均温度(4点平均)
H2_MHE反応(過剰熱:有) と ヘリウムで熱量校正(過剰熱:無)

図②_温度上昇分(②-①[平均温]:過剰熱分)



◇試料内4点の平均温度の温度上昇: ⇒過剰熱の発生の証拠
・「水素のMHE反応時」は、「ヘリウム校正試験時」より温度上昇
・温度上昇幅(過剰熱量)は、ヒータ入力の上昇に伴い増加

図③_過剰熱 (=[平均温度上昇]x[校正係数(温度-熱量)])

◇過剰熱量算定 : 熱量-温度校正係数から算定
・Zrビーズ(MHE反応なしの材料)で、試料4点平均温度の温度上昇から熱量校正係数を算出

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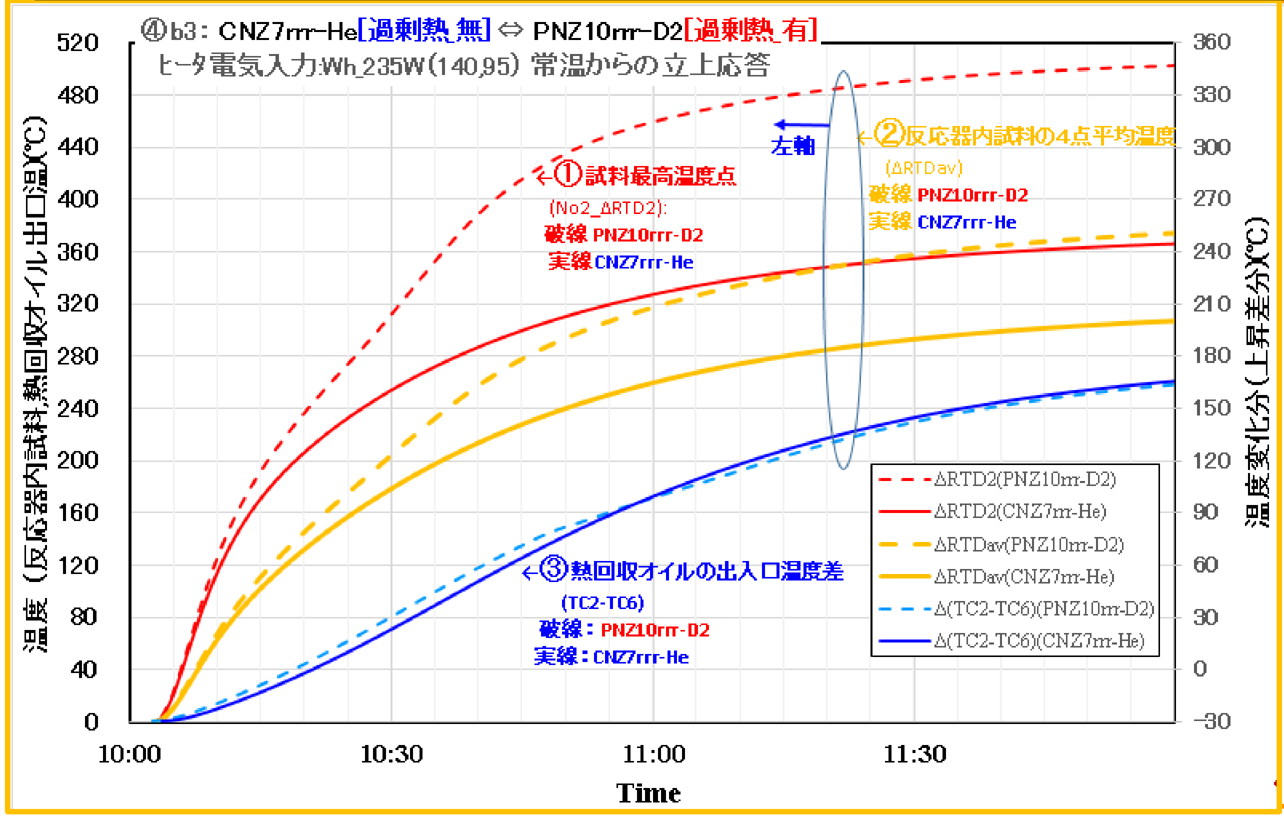
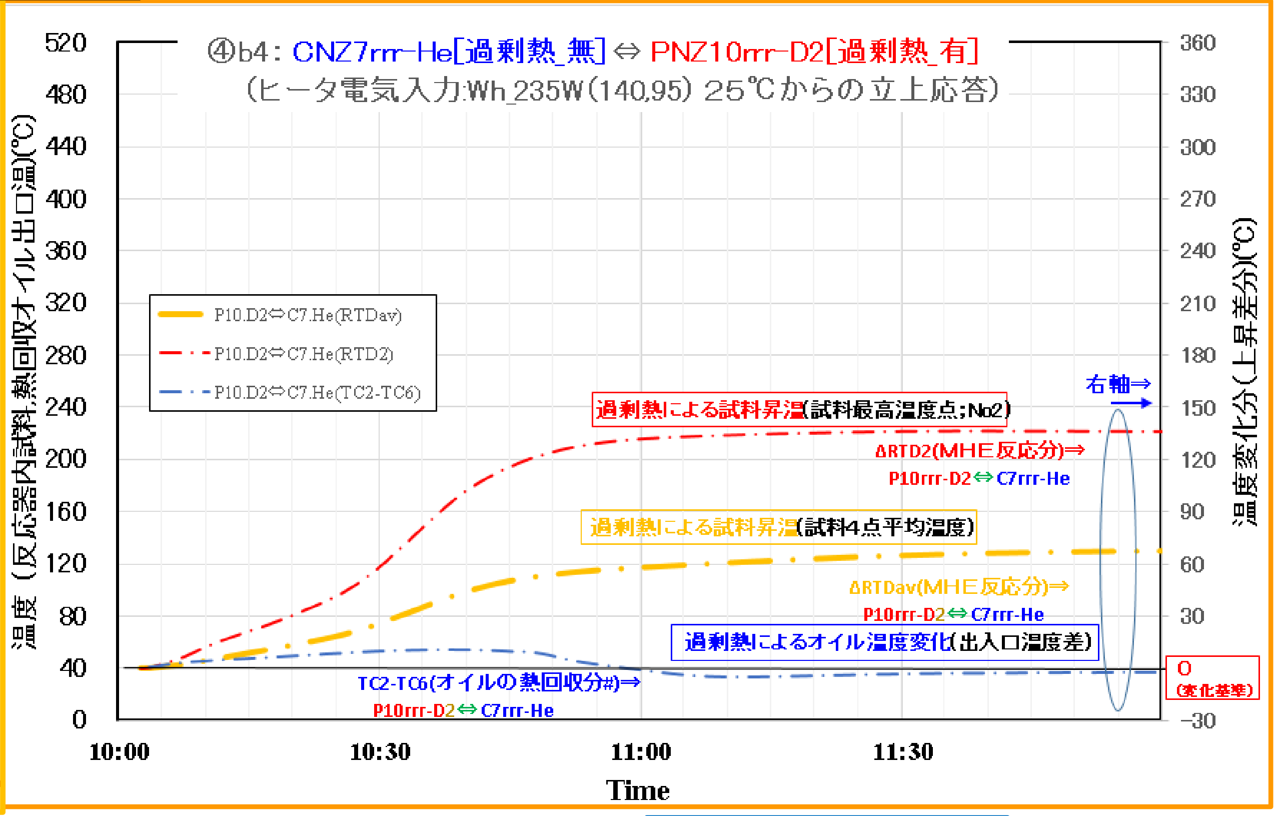




[2] 熱回収オイルの出入口温度差の過渡変化(③)

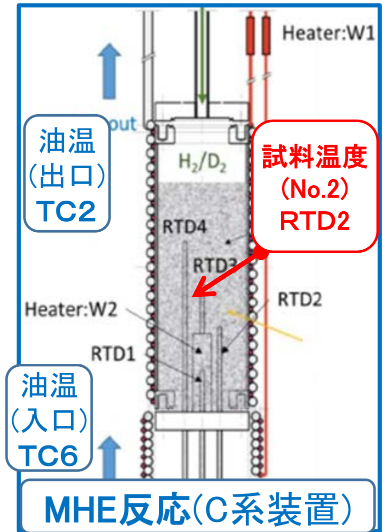
・D2 [過剰熱_有] (破線)は、He_校正[過剰熱_無](実線)より180℃付近までは温度が高いが、それ以上では同等か、逆に少し低い。(オイル沸点(360℃)以上で内部沸騰の潜熱吸熱で低下!)

⇒過剰熱発生のこの温度域では、C系装置のオイル熱計量は対応不可　⇒装置改良D系へ

[1] 試料の温度上昇の過渡変化　(①試料平均温度　②中央部No2[下から2番目60mm])

・D2_MHE反応[過剰熱_有]は、He_校正[過剰熱_無]より温度上昇。特に中央部2の上昇が大

・温度上昇に伴い、250℃領域から急激に温度が上昇している。



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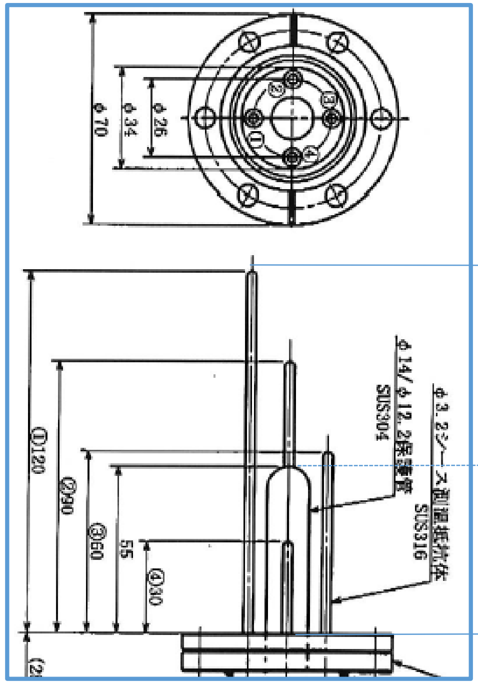
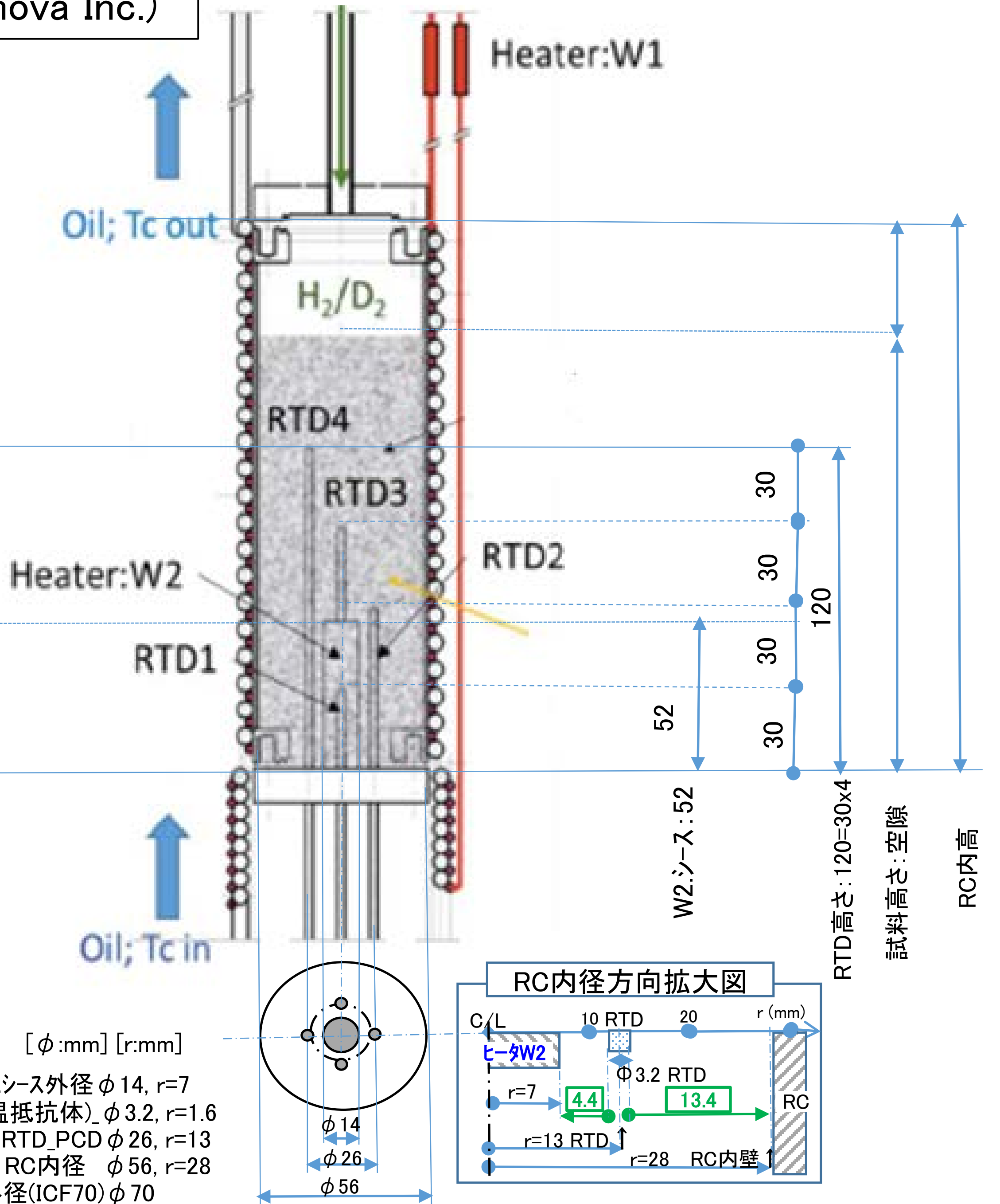
反応器：RC(Reactor Chamber) for Kobe C-System





◇RC内容積_:
1)チャンバー(φ xL):
2)
3)水素配管-SNVまで:

[φ:mm] [r:mm]

ヒータW2.シース外径φ14, r=7
RTD(シース測温抵抗体)_φ3.2, r=1.6
RTD_PCDφ26, r=13
RC内径 φ56, r=28
RCフランジ外径(ICF70)φ70

(P30, 2018.03.02 常温核融合研究の現状.pdf)