Lecture notes

Overview on thermometry and calorimetry methods used in LENR studies

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Outline

- High temperature thermometry
- Medium temperature calorimetry
- Clean Planet apparatus example
- Room temperature pre-loading
- Considerations for any of these
  - Pro/Cons
  - Geometry, setup
  - Specifications
  - Complexity, rolling costs, feasibility
  - Characterizations and expected data

Forewords

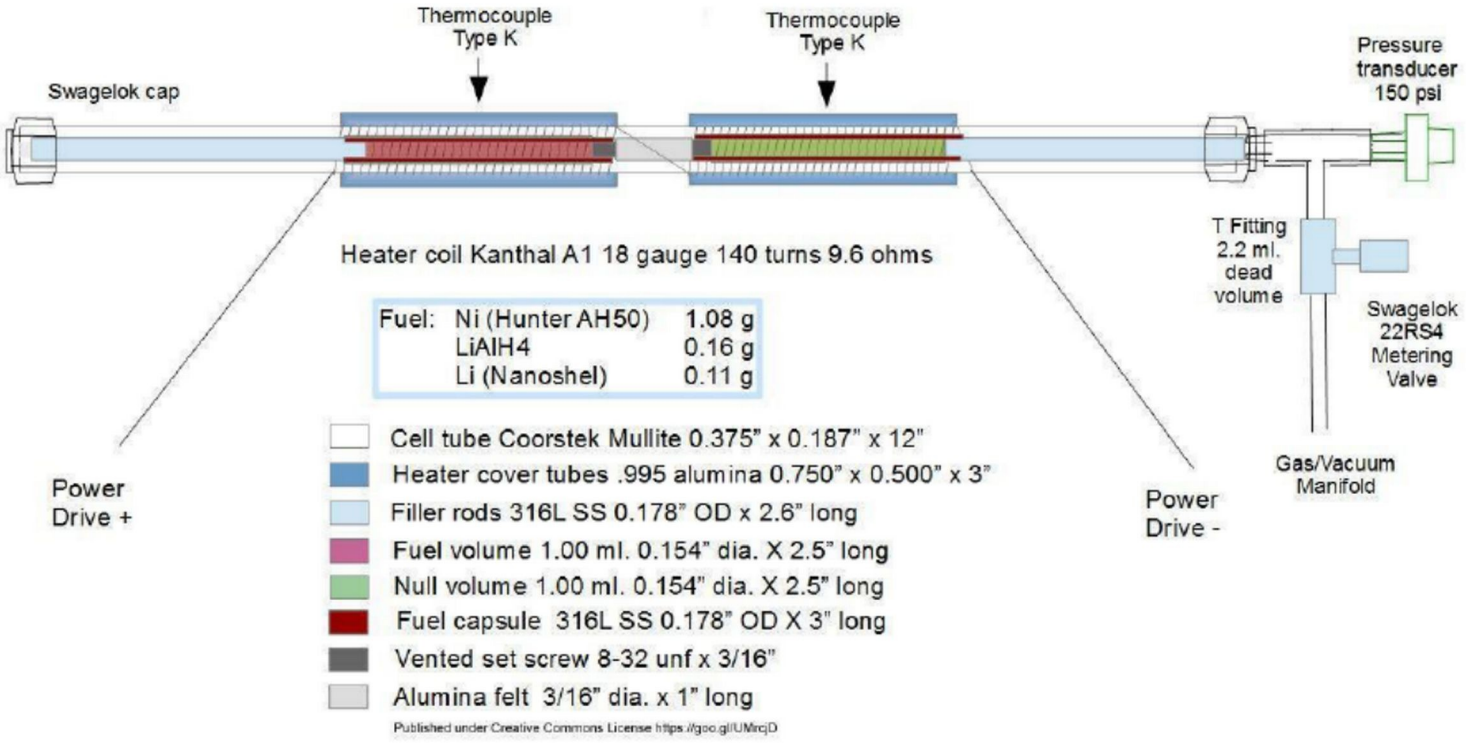
- Experimental calorimetry science is a pain!!!
- We don’t have to choose only one
- One design cannot fit all experimental conditions
- Plan the construction and work out the process in advance
- Examples given are for discussion
- Expected results, objectives of this reactors
  - Have a demonstrator for the public to see
  - Prove to us it works
  - Collect data about nuclear events in these setups

High temperature thermometry

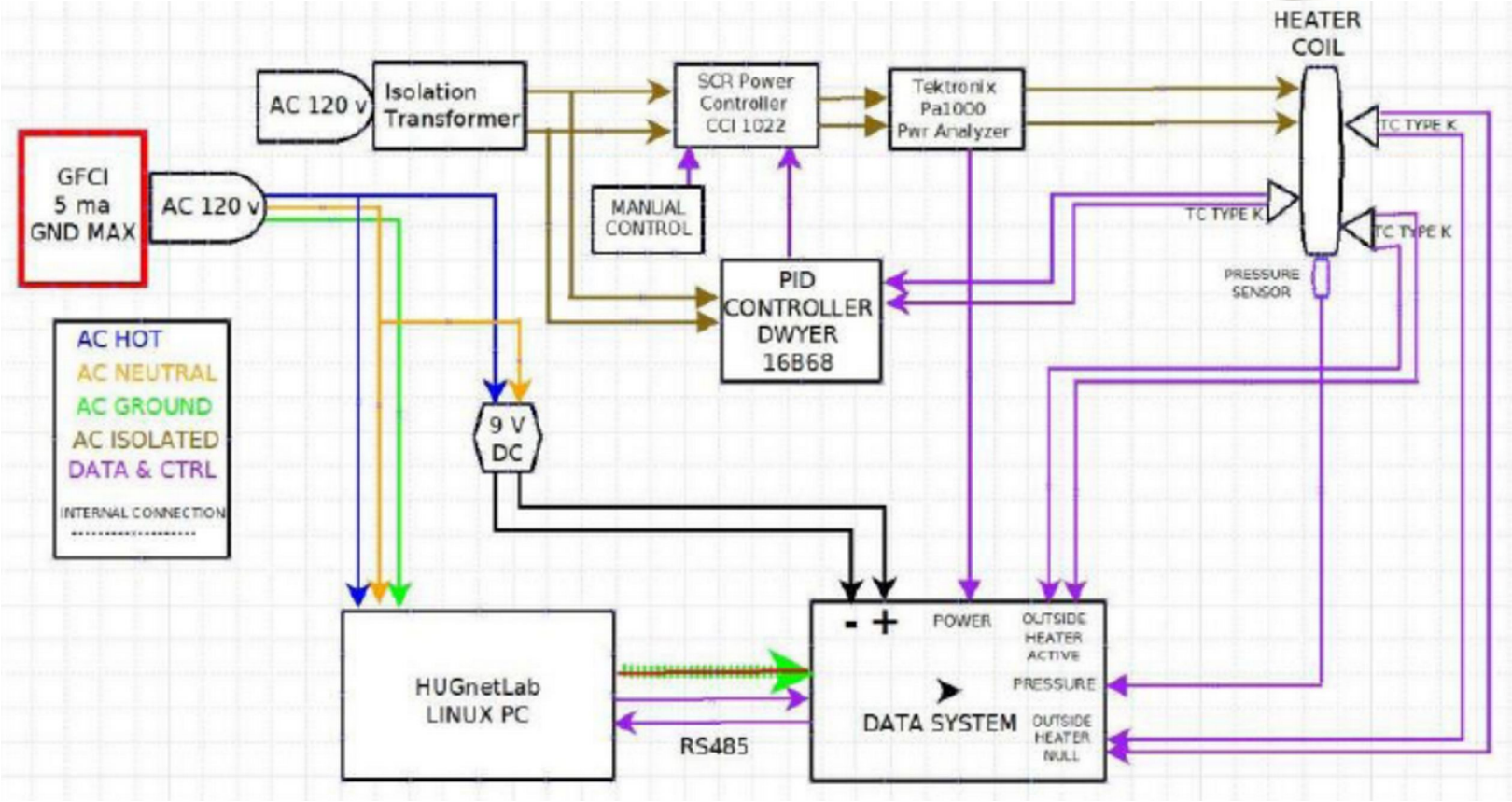
- Advantage
  - High temperature amplitude
  - Materials are cheap
  - Can be set up very quickly
  - Quick turnaround between experiments
  - Versatile
  - Easy to repair
- Disadvantages
  - Need to change some parts every time, this induce a potential replication issue (e.g. if the manufacturer changes the composition)
  - Require training on specific aspect of experimental science
  - Difficult to assess small excess energy results
  - Cleanness is not 100% in control
  - Small pressure (but does it matter?)

High temperature thermometry

- Geometry



High temperature thermometry



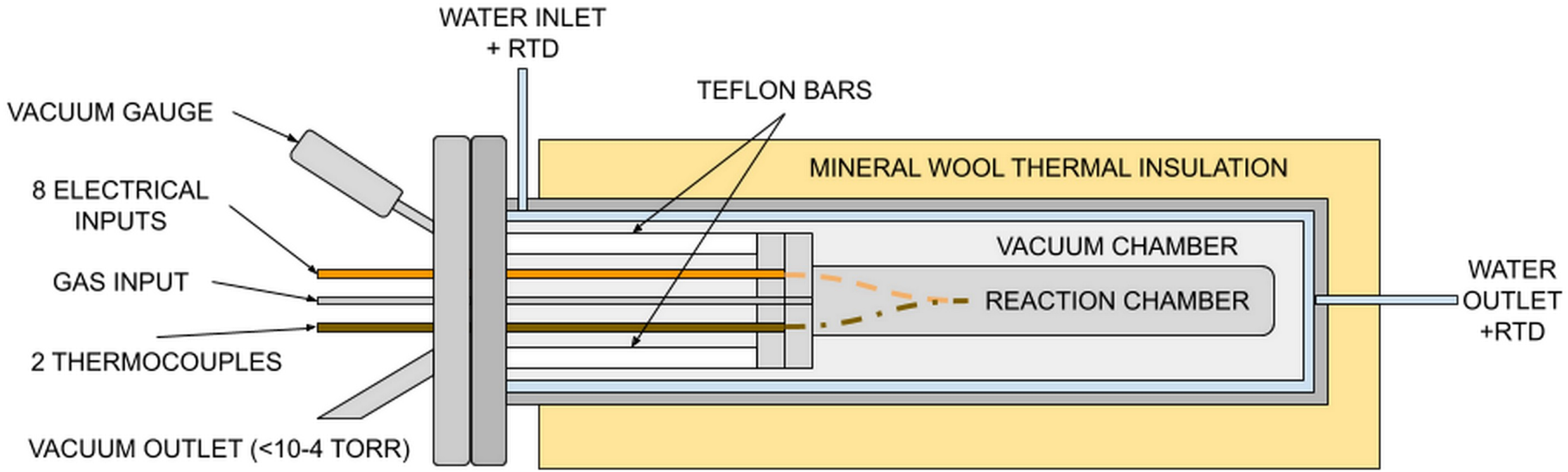
Capabilities of this setup

- Temperature amplitude: RT to 1100ºC
- Pressure: vacuum to 3 bars
- Duration of the experiment: 8 hours
- Preparation for experiment: 2 weeks
- Type of samples: Powder
- Precision of the results: 1W resolution, 10W precision

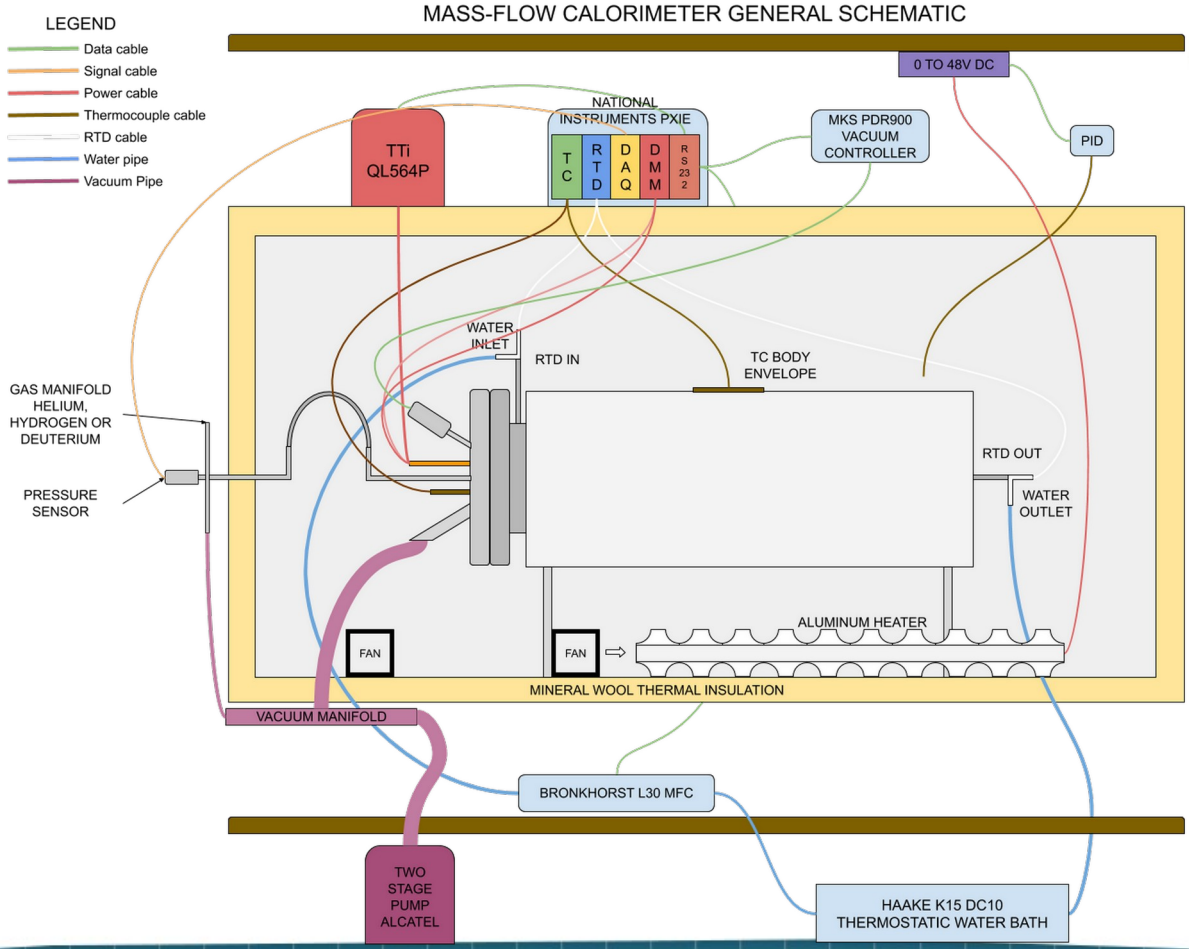
Medium temperature calorimetry

- Advantages
  - Setup is more precise
  - Better handling of the parameter space
  - Reliable results
  - Replicability is high
- Disadvantages
  - Complex, tedious, long and time consuming to produce
  - Takes more time to setup between experiments
  - Lower temperatures reached
  - Expensive to very expensive
  - Require automation
  - Require simulation before production, results are not straightforward
  - Almost no versatility, initial design will define capabilities, not change allowed

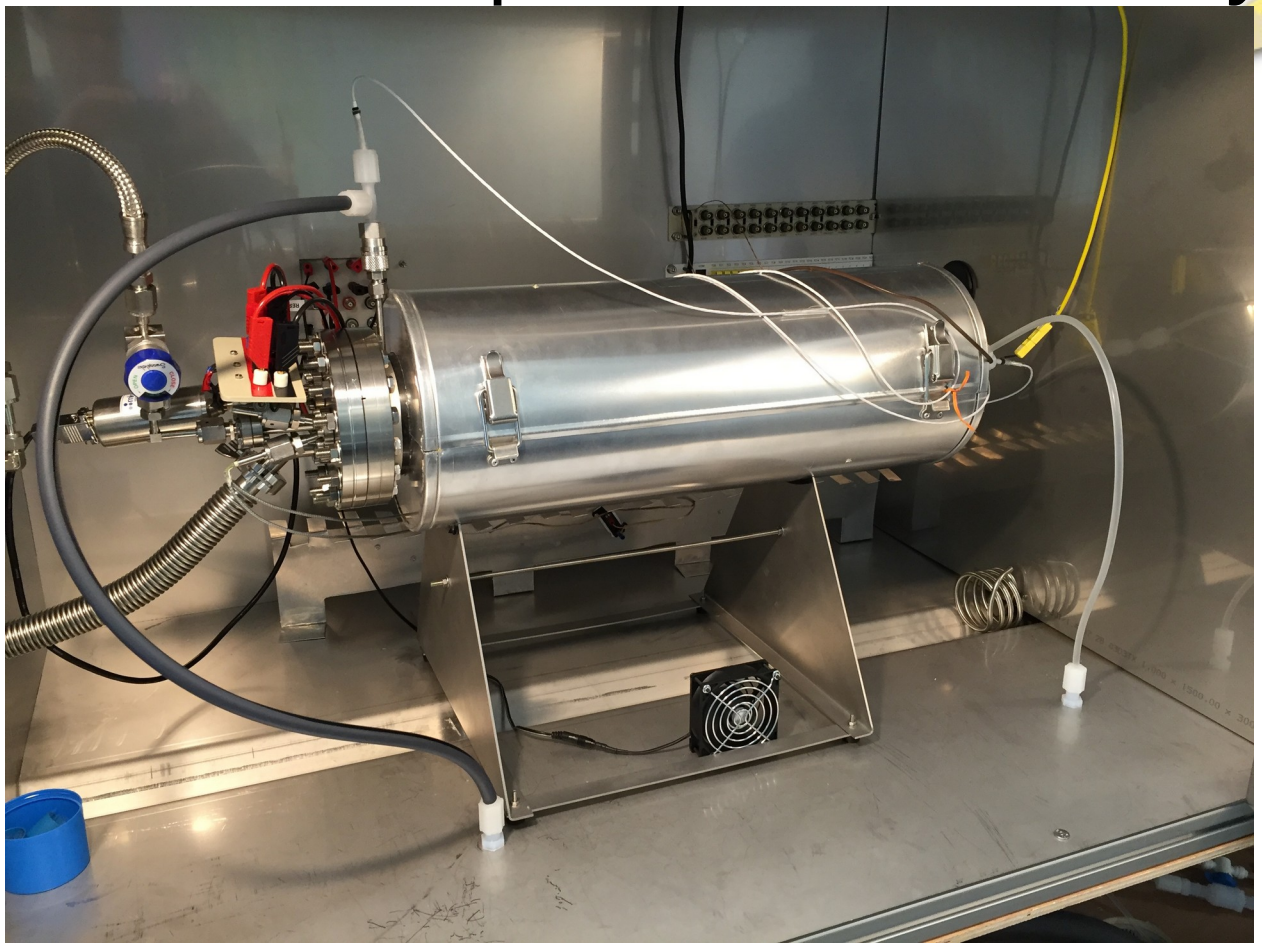
Medium temperature calorimetry



Medium temperature calorimetry



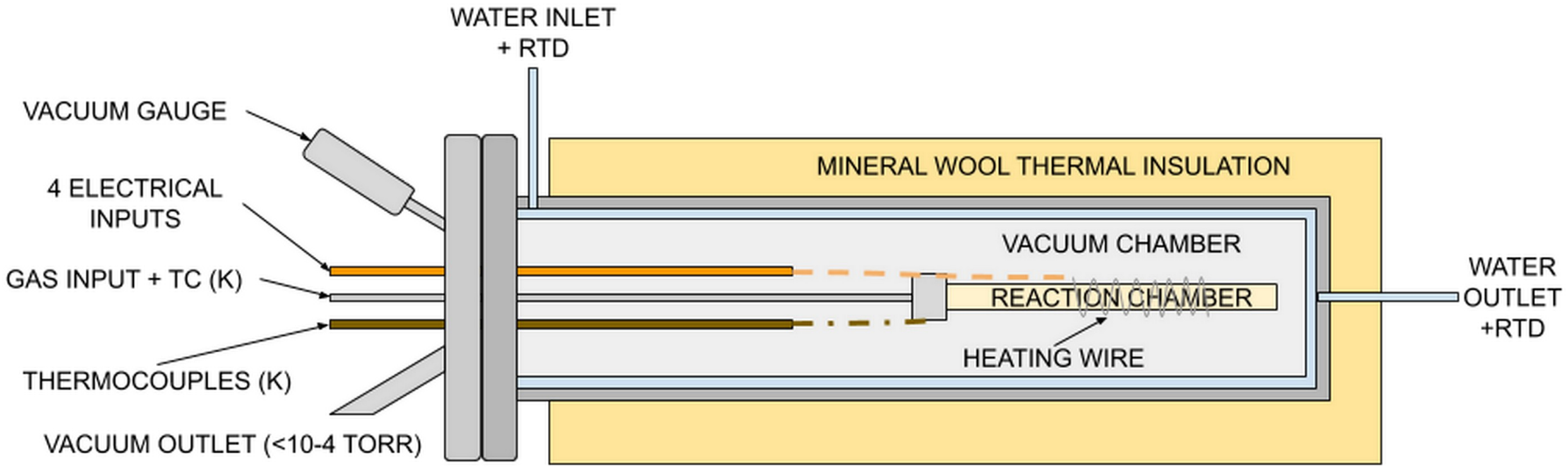
Medium temperature calorimetry



Capabilities of this setup

- Temperature amplitude: 77K to 800ºC
- Pressure: High vacuum to 10 bars
- Duration of the experiment: Few hours to weeks
- Preparation for experiment: 1 month
- Type of samples: Powder, rod, plates, targets
- Precision of the results: 10mW resolution 1W precision

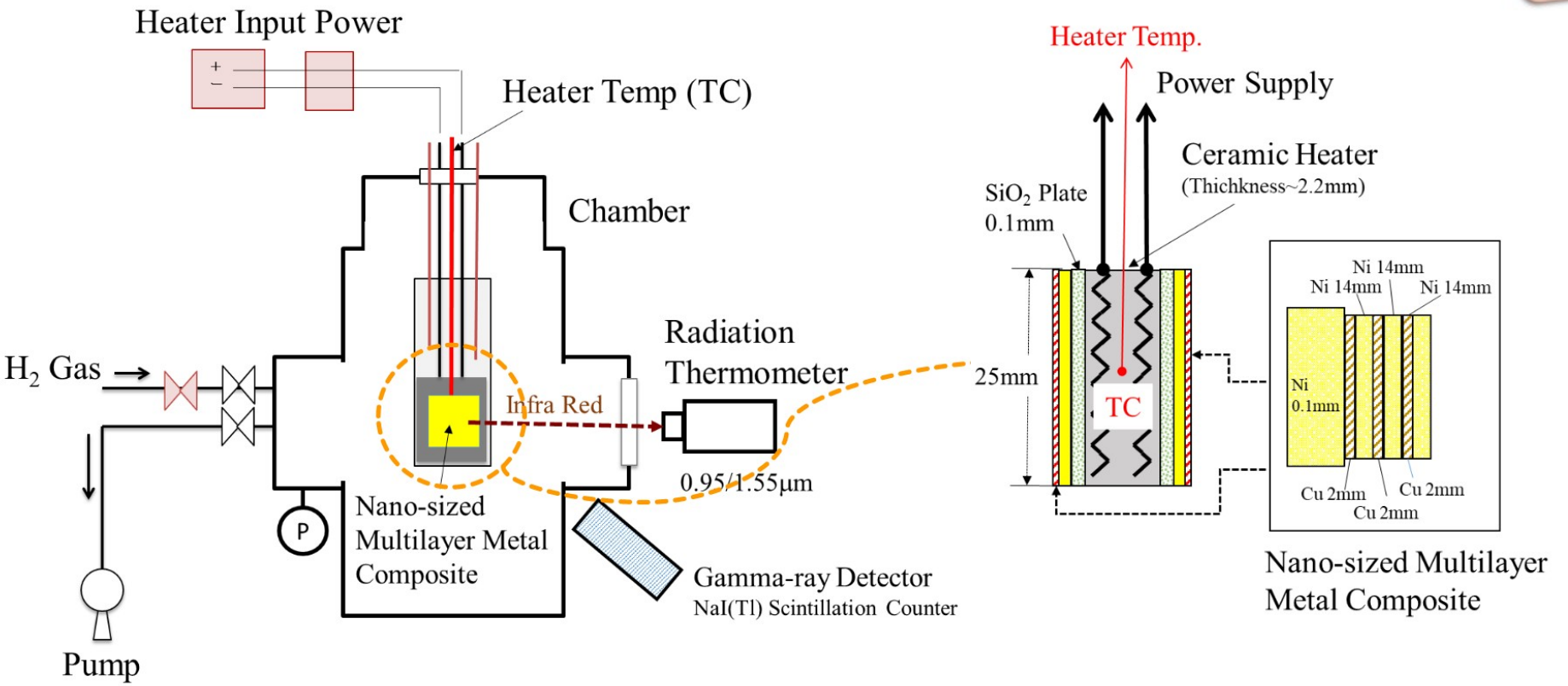
Medium temperature calorimetry



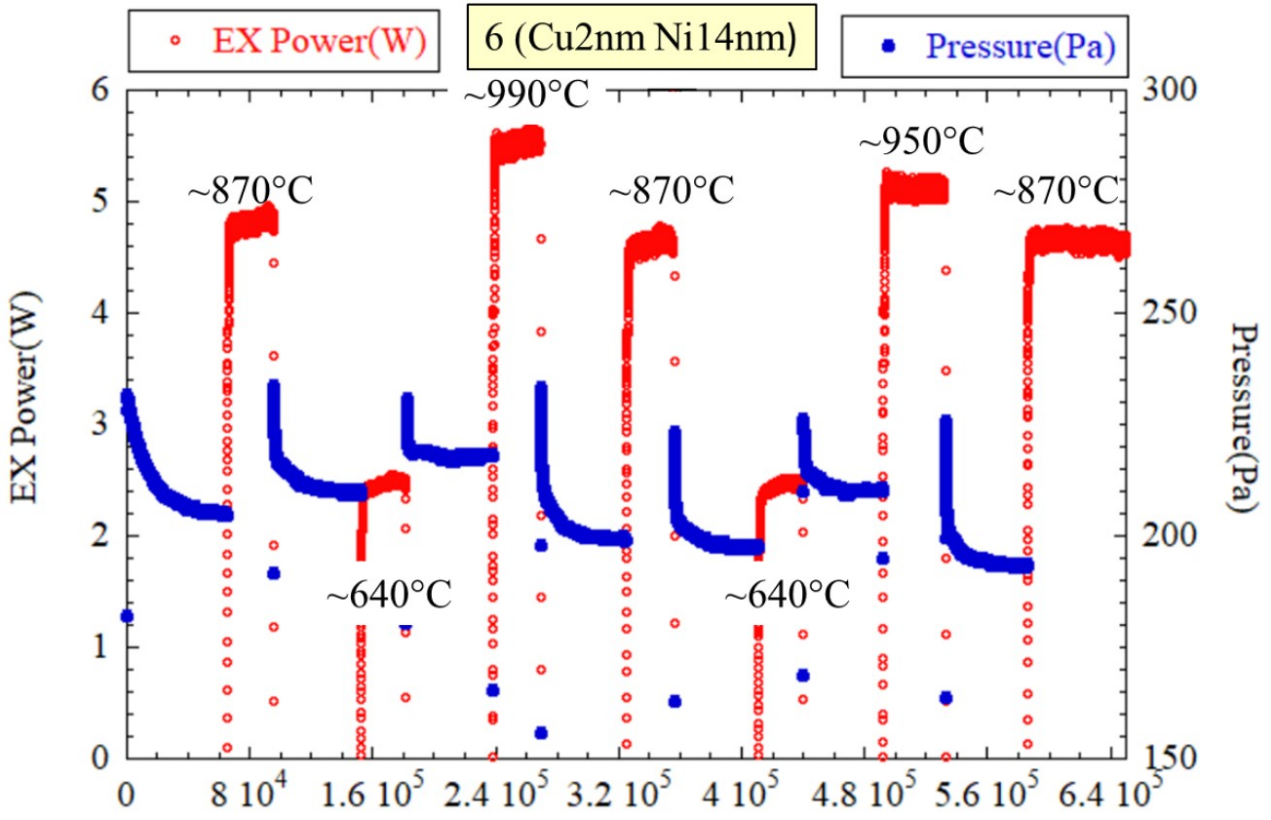
Clean Planet Apparatus

- Material science is developed for a long time by Iwamura
- Results are interesting
- System is build our of vacuum equipments
- It is not cheap (~10 000 PLN)
- One experiment takes a week to prepare at least
- This is not calorimetry, but thermometry
- We don’t know enough to replicate…

Clean Planet Apparatus

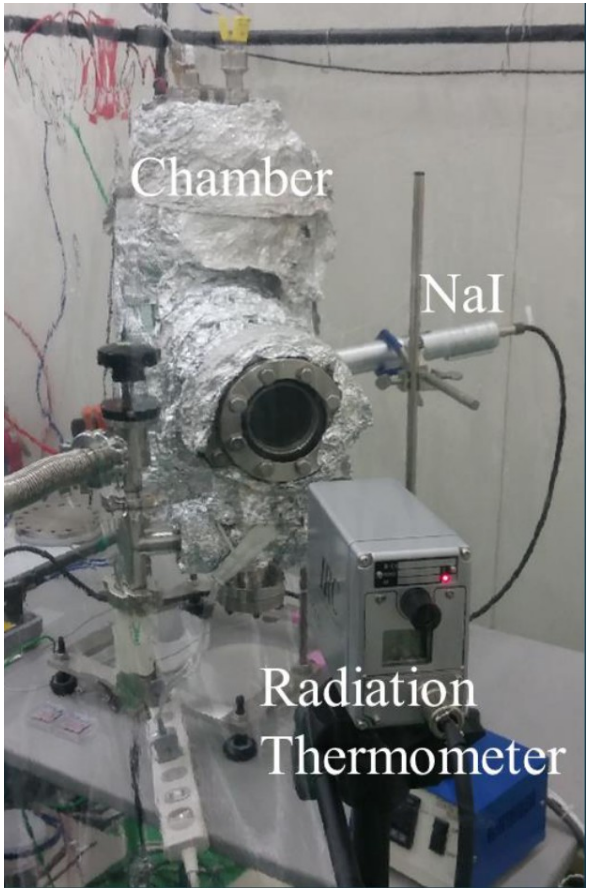


Clean Planet Results



- Sample reaches 1000ºC in the reactor
- Heat is produced when vacuum is pulled out
- The replicability within the experiment is not 100%
- The duration of the experiment require a week of man hours to sustain operation
- We don’t know the baseline for heat production
- 900ºC gives 5W excess energy

Clean Planet Apparatus



- Advantages
  - Nuclear measurements
  - Sample can reach 900ºC
  - Can test powders or bulk materials
  - We have at ZUT the system to prepare these samples
- Disadvantages
  - Hybrid thermometry via infrared camera
  - It is not cheap
- Open questions
  - How much cycles is the sample capable of operating?
  - Does it wear-off at some point?
  - Yield of energy produced is small…

Thank you!

Any questions?

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