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Temperature controlled oscillatory and runaway processes

Presenter:

Andras Kovacs (BroadBit)

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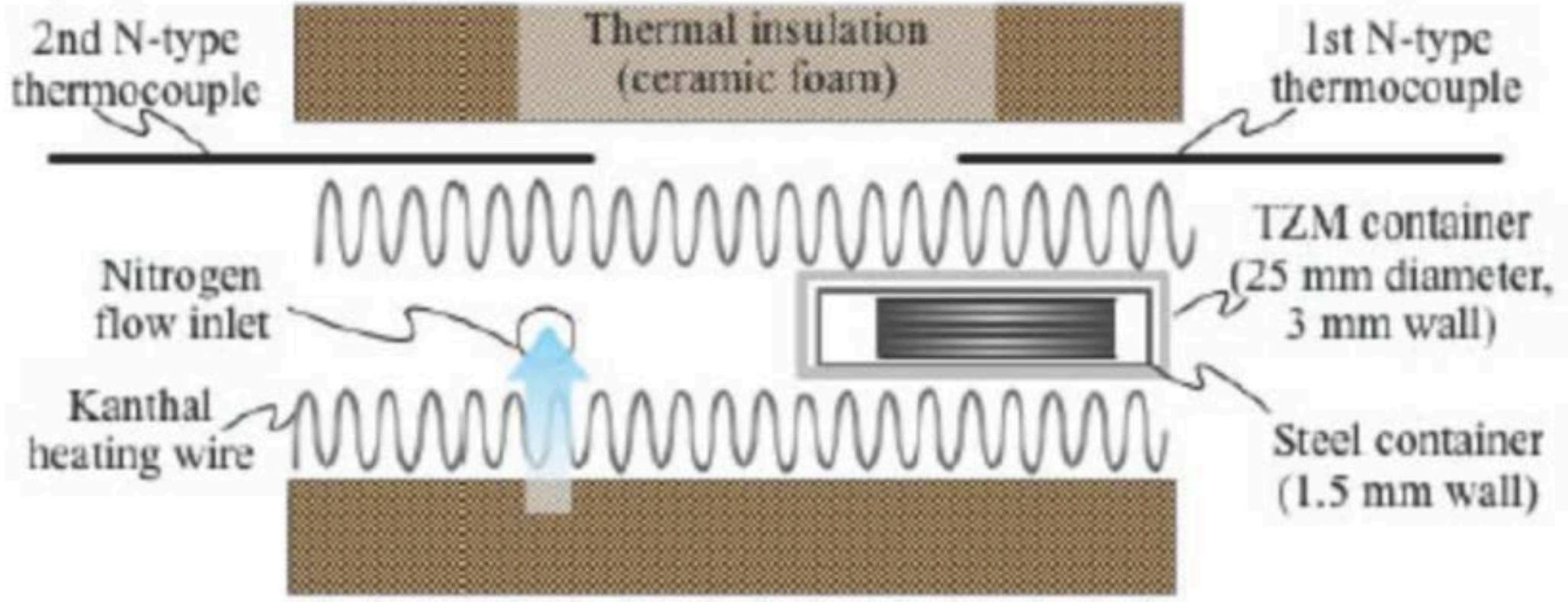
*email: andras.kovacs@broadbit.com

Experimental setup

Fuel composition: 10 - 15 g CuNi alloy and 0.5 - 1 g Li

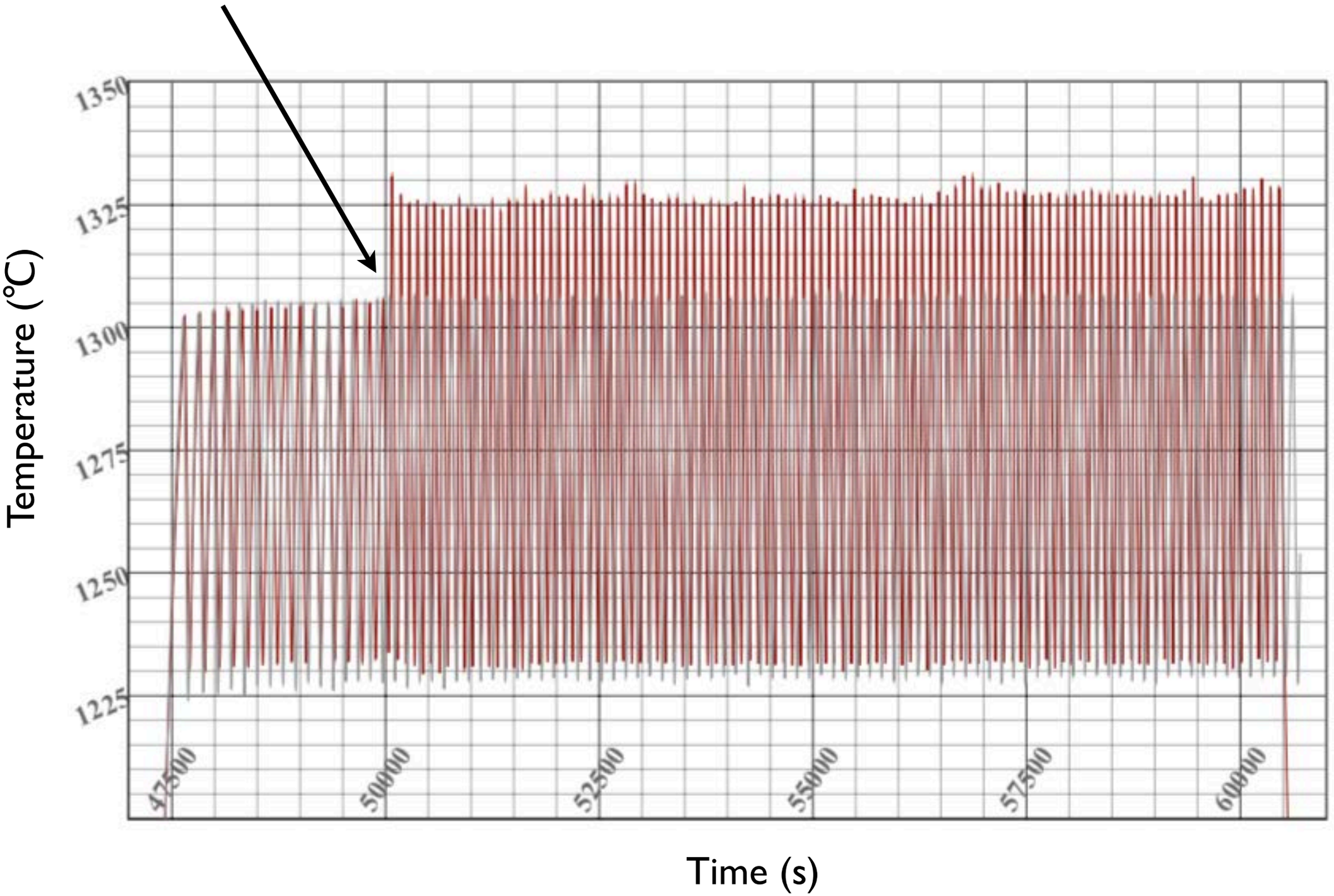
Enclosed in a welded metallic container (FeCr alloy, or double container of steel + molybdenum)

Normal operation: Temperature cycling in the 1240 ℃ - 1300 ℃ range



Temperature cycling

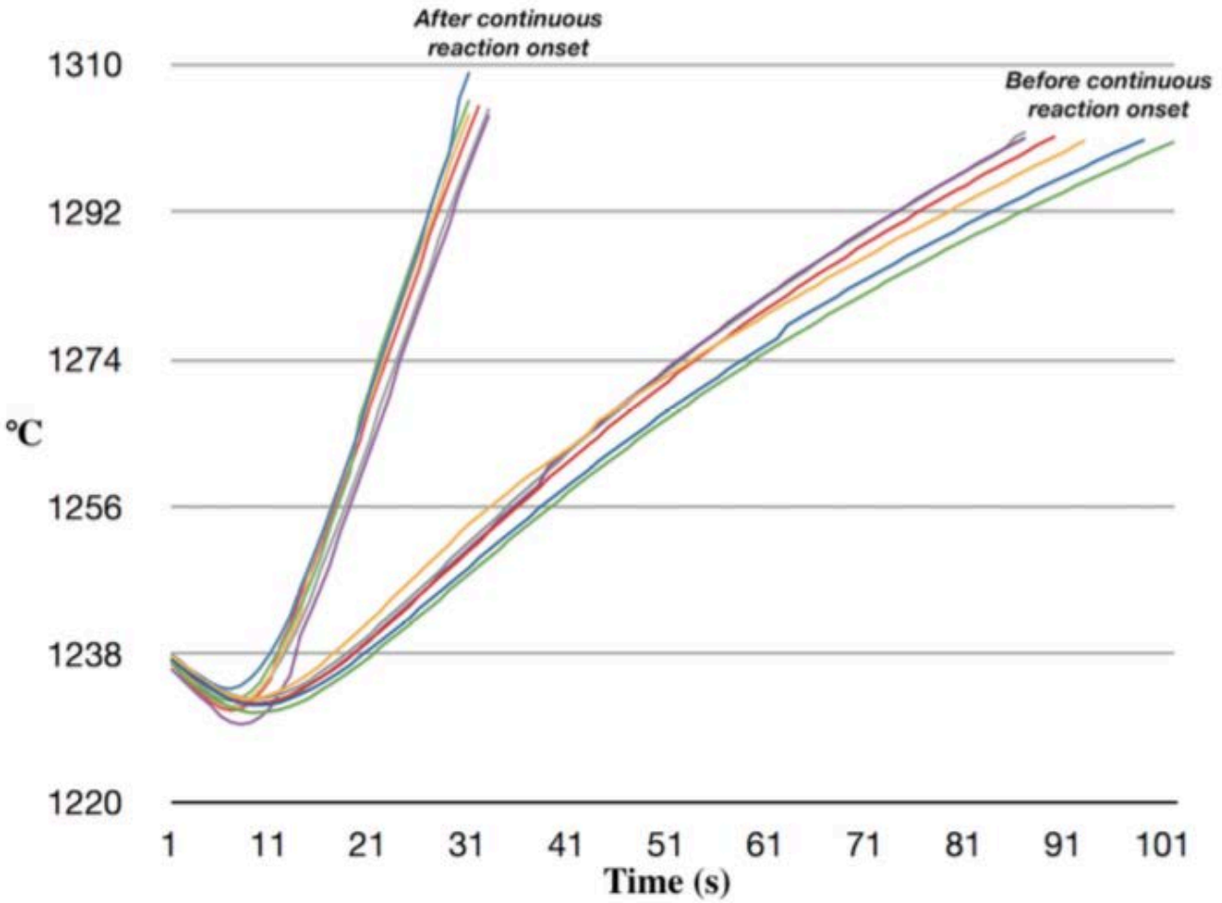
Start of exothermic reaction



Gray: calibration (without fuel)

Red: with fuel

Excess heat during temperature cycling



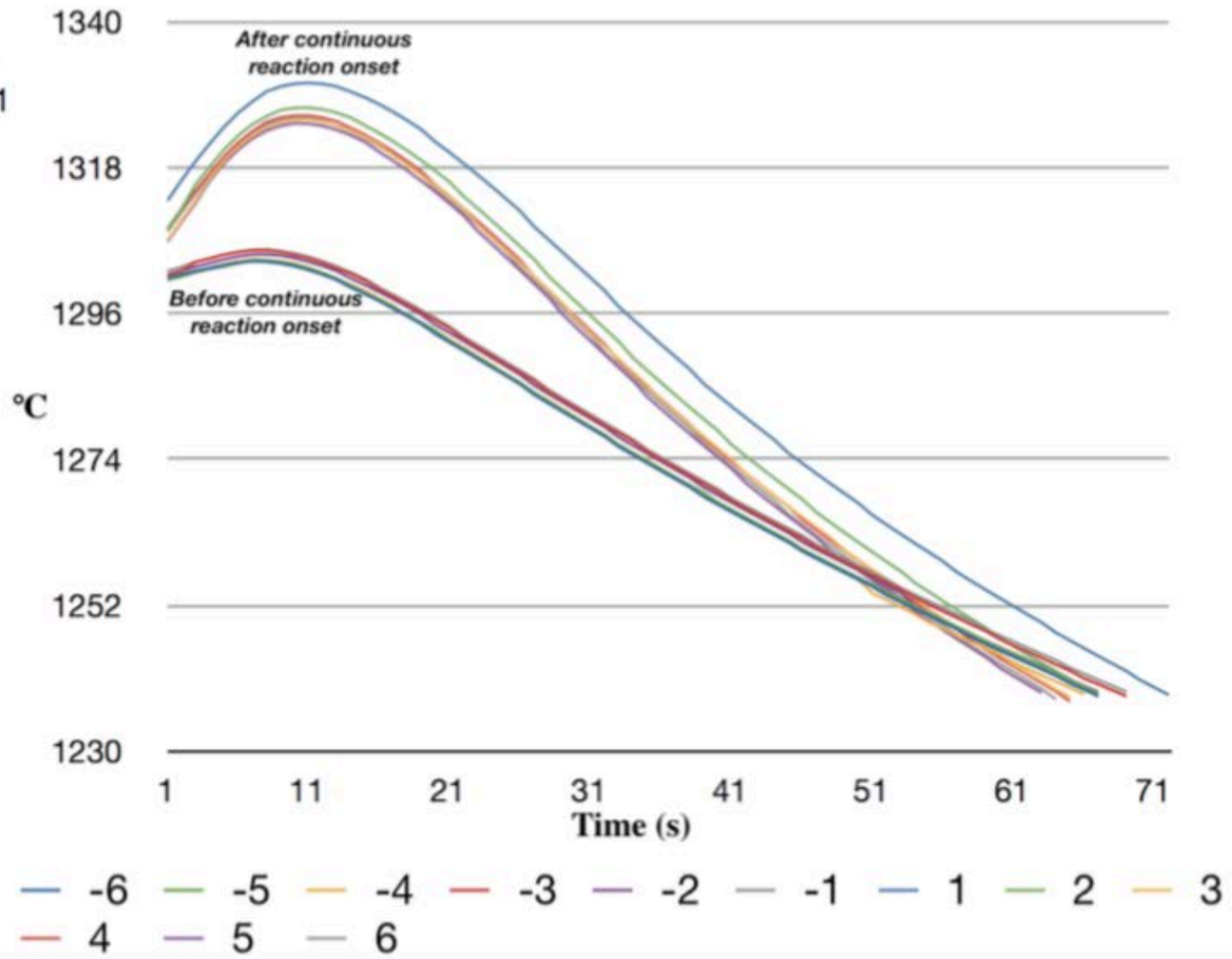
Heating phases

Excess heat: 300 W average over time

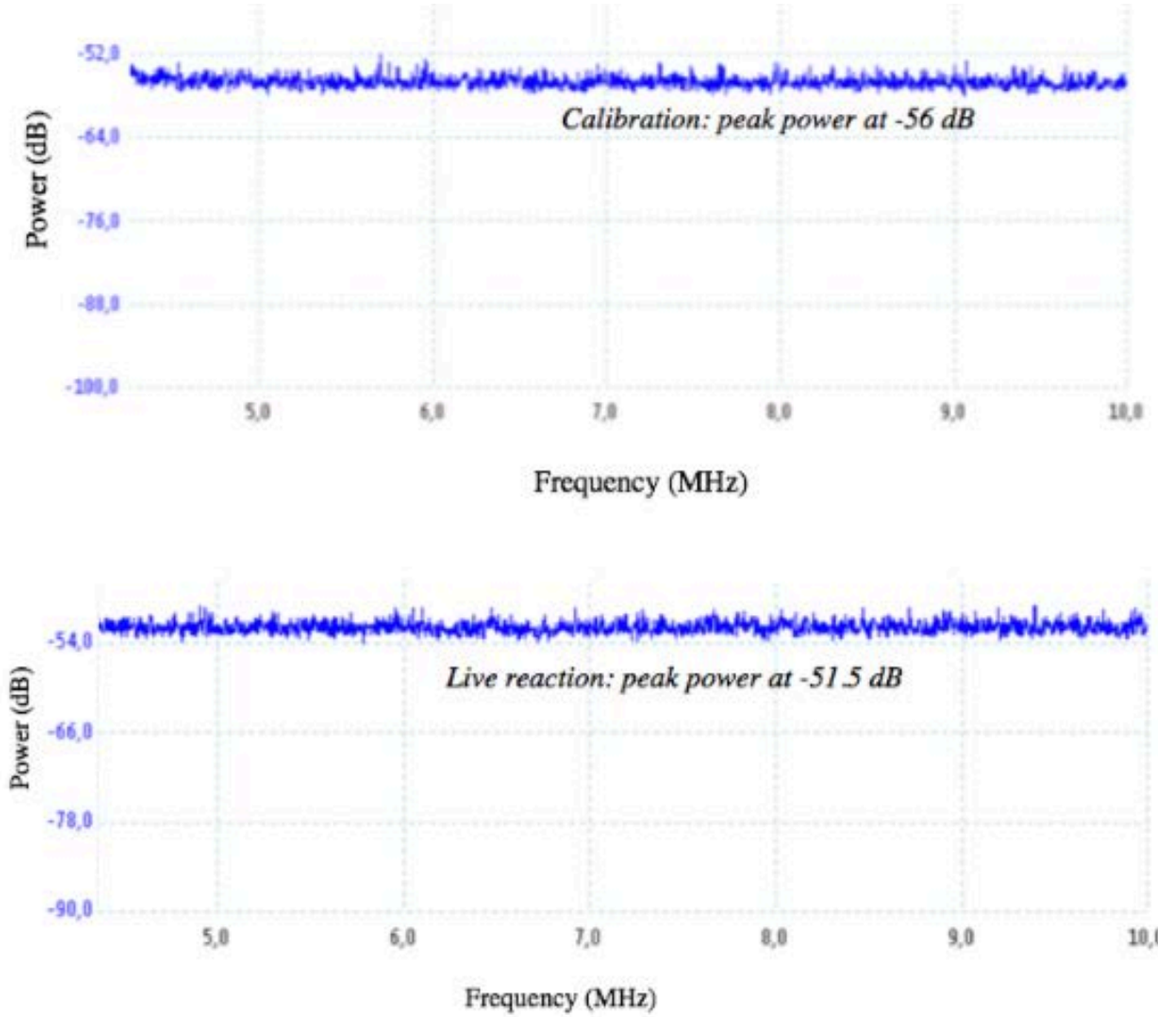
Specific heat: 30 W/g of fuel
Excess heat production is mainly during heating phase!

Note the stable dynamics, evidenced by overlapping curves.

Cooling phases



Radiation during temperature cycling



Radio frequency measurements in the heater off condition, showing a flat power spectrum

The reactor emits RF radiation.

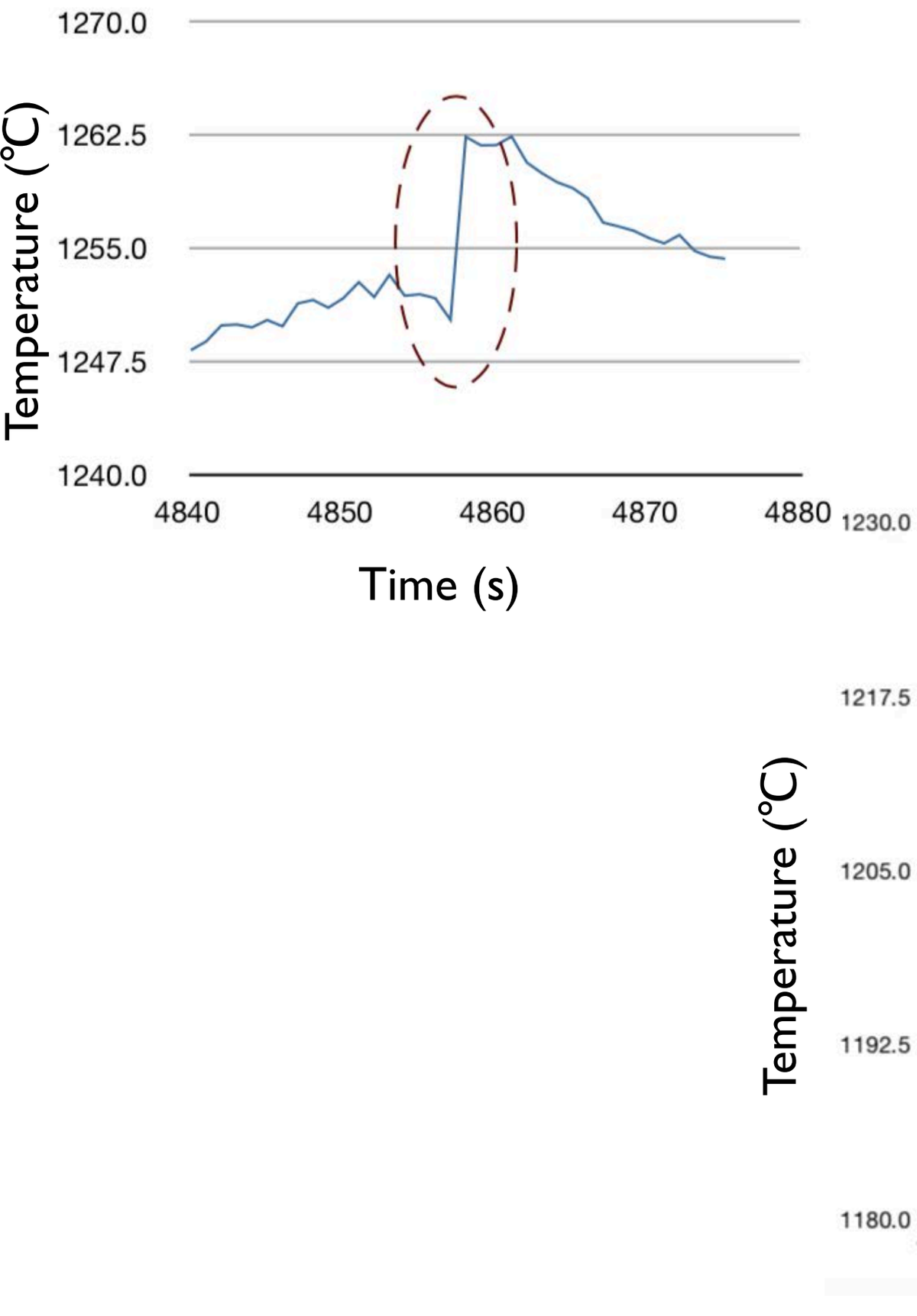
Emitted RF power is 4 times stronger during heating than during cooling.

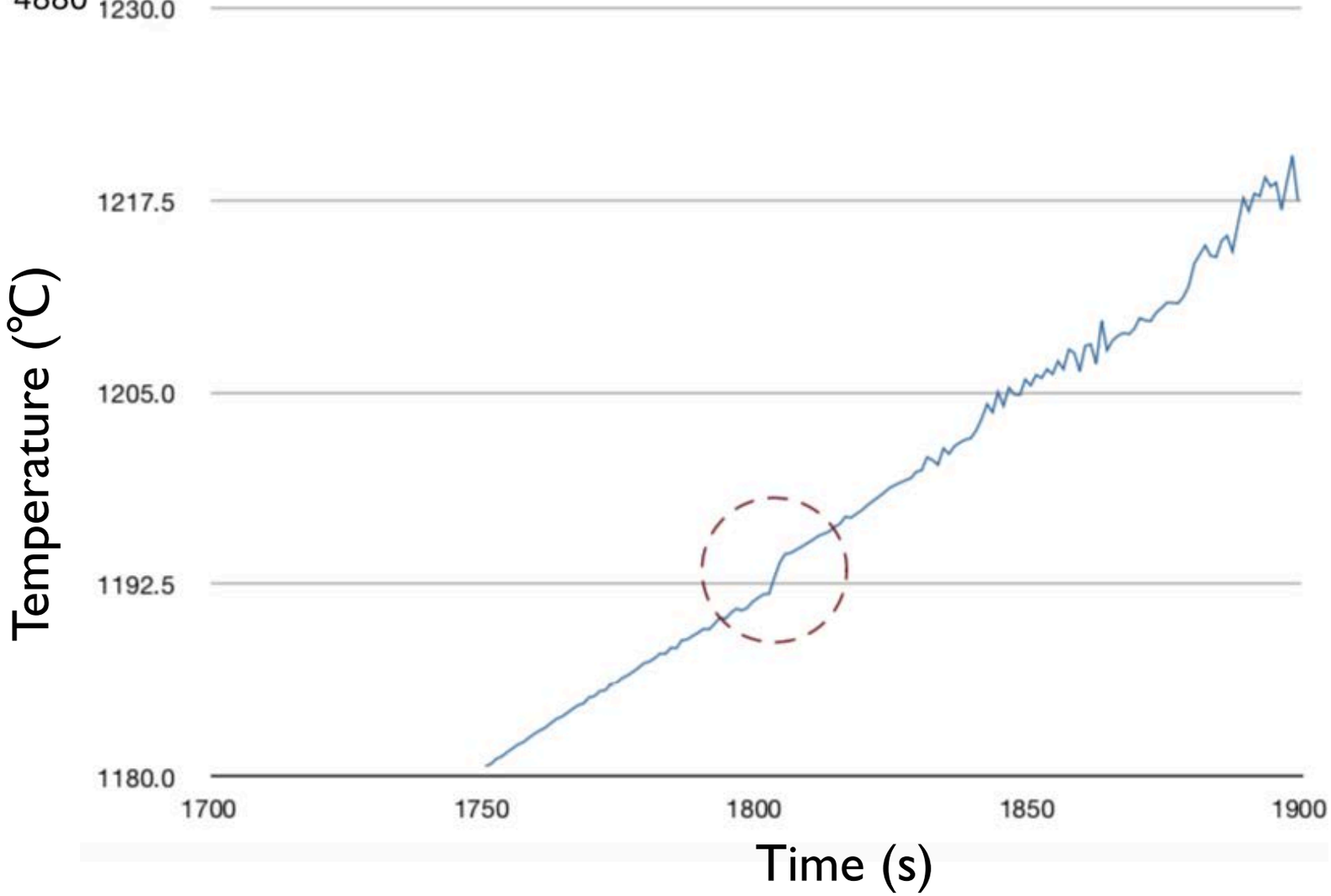
Condition	Power relative to background noise
Background noise power	1
RF power from the reaction, cooling phase	1.8
RF power from the reaction, heating phase	4.3

The RF emission power by the fuel under temperature cycling

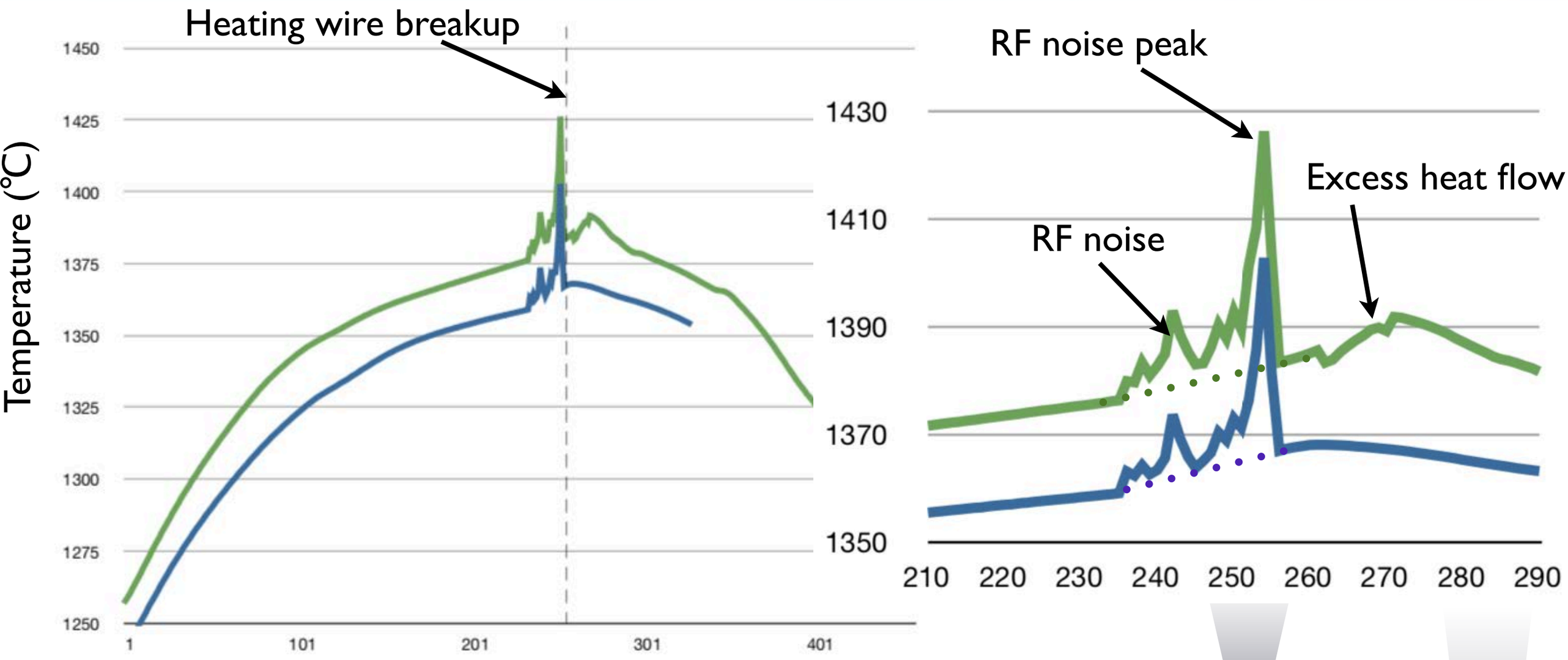
No emission of gamma radiation (same spectrum as background).

Occasional temperature jumps during cycling





Runaway process starts near 1350 ℃



Runaway process can be triggered by applying continuous heating

Green thermocouple is near the fuel container, blue one is further away

Geiger counter reading during this time period: gamma radiation is **40** times higher than background

Geiger counter reading after reaction: same as background

Containers after runaway events

Molybdenum container after temperature run-up to 1350 ℃

Calorimetry measurement proved that the container was nowhere near its melting point (2600 ℃).

What causes these strange meltdown events?