RAISELIFE

Solar accelerated aging test on different coatings:

Evolution of the absorptivity, and next characterization planed

17th May 2017, Raiselife dissemination Workshop – Madrid

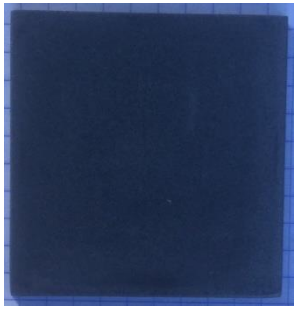
Reine REOYO-PRATS , PROMES - CNRS

WP3 - Receiver Coating	**Solar accelerated aging test on different coatings**	PROMES

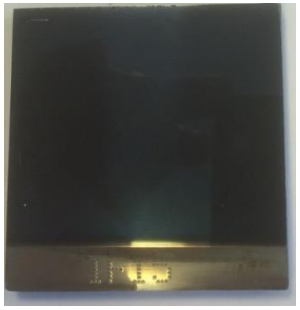
First solar accelerated aging tests on T91 samples, with 4 different coatings :

Ceramic absorbing paint

Protective aluminide coating + Ceramic absorbing paint



Multi-metallic diffusion coating (Cr – Mg)



Solar selective magnetron-sputtered coating

WP3 - Receiver Coating	**Solar accelerated aging test on different coatings**	PROMES

I/ Presentation of the SAAF : Solar Accelerated Aging Facility

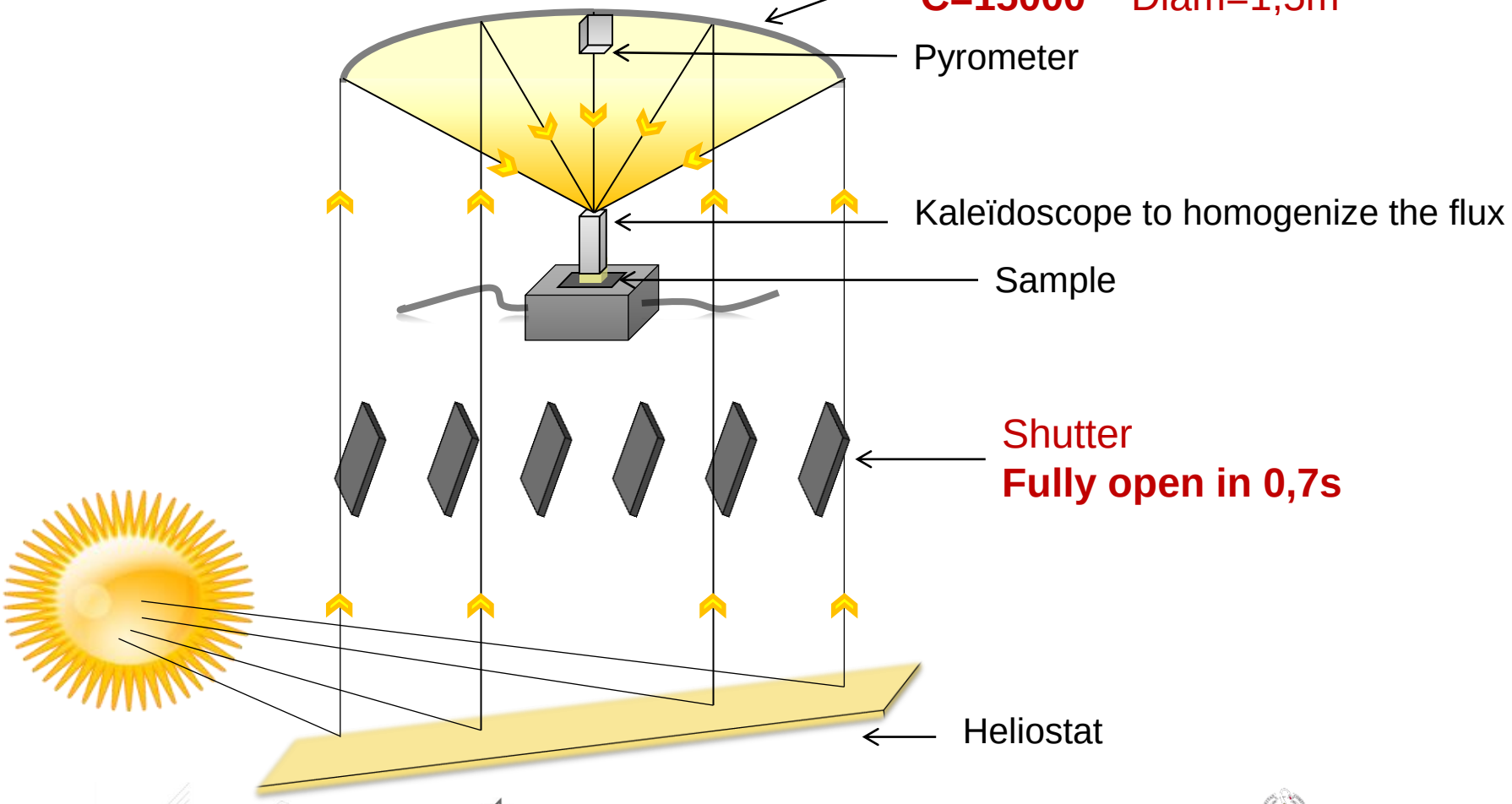
II/ Aging cycles applied

III/ First results : evolution of the absorptance

IV/ Other characterizations expected :
conductivity and diffusivity with photothermal experience

WP3 - Receiver Coating

I/ Presentation of the SAAF Solar Accelerated Aging Facility



WP3 - Receiver Coating	**II/ Aging cycles applied on T91 samples**	PROMES

- Requirements :
  - Maximal temperature similar to the real conditions : 650 °C
  - Maximal flux similar to the real conditions : 500 kW/m²

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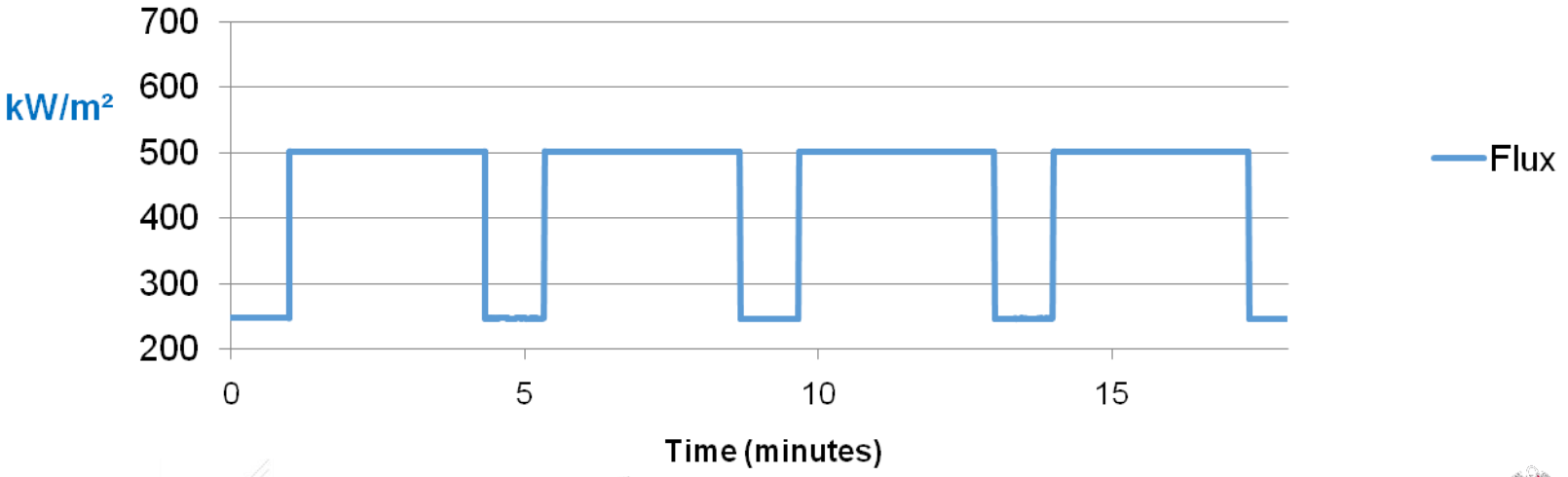
- Testing conditions applied to provide an accelerated aging :
  - **Quick variation of the flux : 250kW/m²/s**



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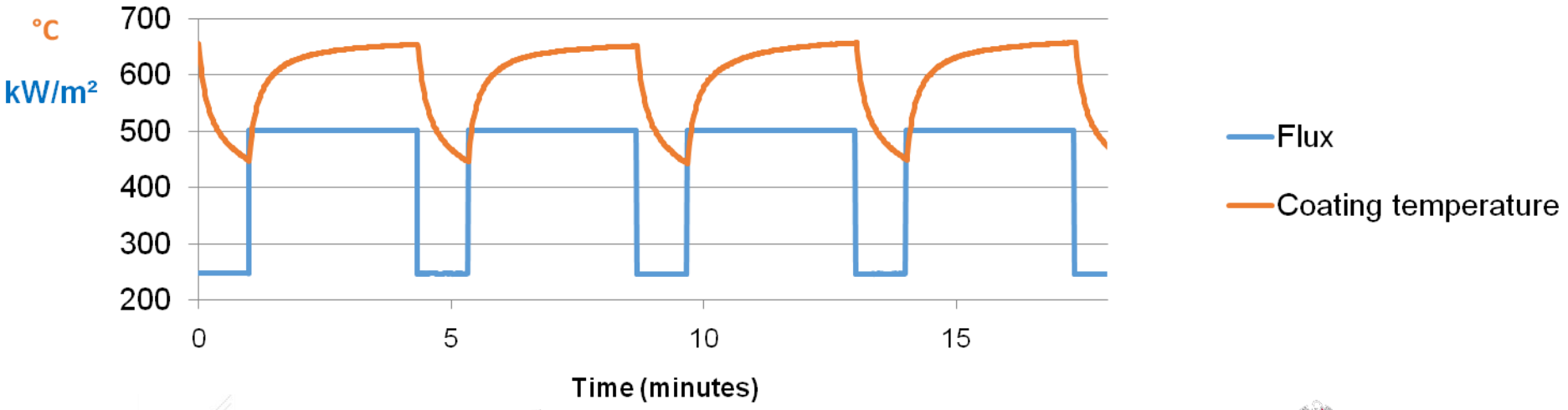
    - → High gradient temperature



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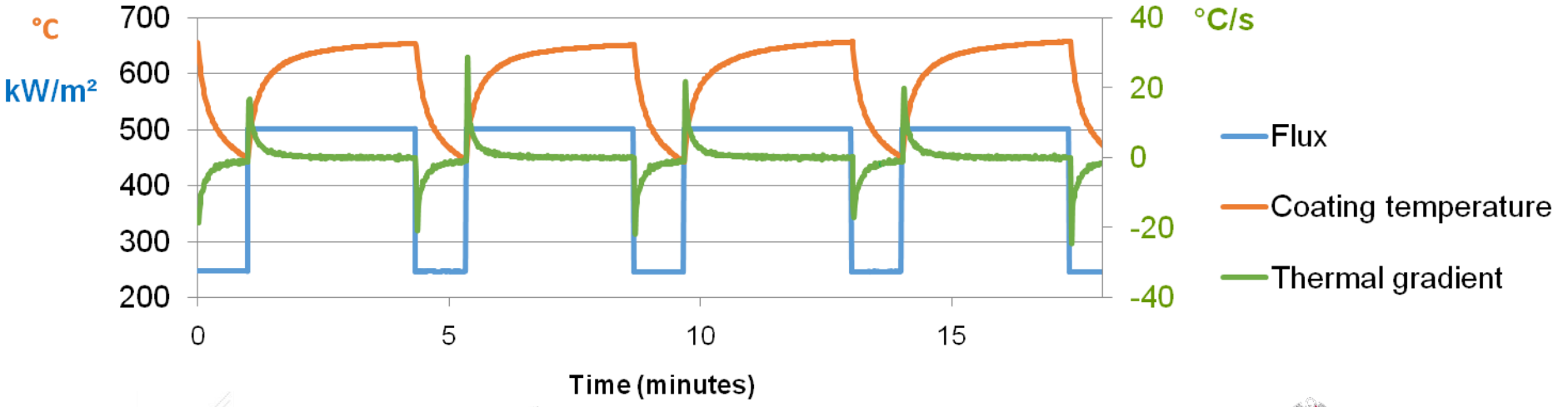
- Testing conditions applied to provide an accelerated aging :
  - **Quick variation of the flux : 250kW/m²/s**
    - → High gradient temperature : about **25°C/s**
  - Short cycles : 4 minutes/cycle
    - → About 70 cycles/sunny day (high & stable DNI - Direct Normal Irradiation)



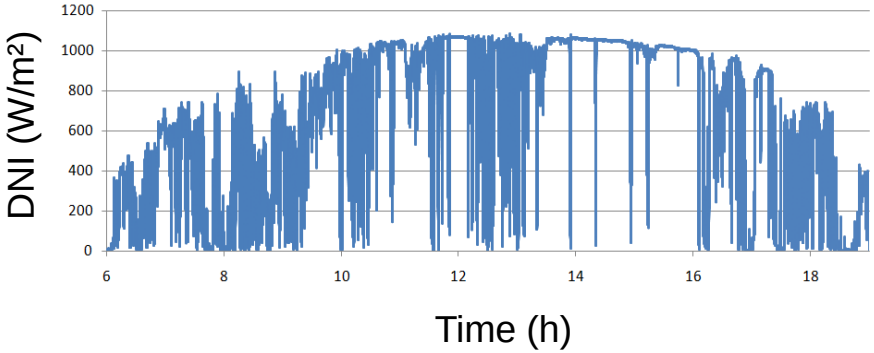
WP3 - Receiver Coating	**II/ Aging cycles applied on T91 samples**	PROMES

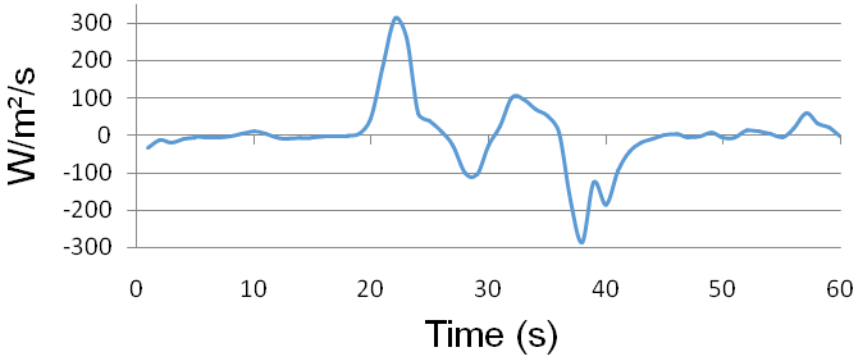
- Comparison with gradient flux in real conditions

  & Application of a concentrator factor of 700

  - Example on a cloudy day : 2 april 2017

    → Variation of 300 and -300 W/m²/s in less than 1 min ⇨ **210 kW/m²/s**





  - Study based on 30 consecutive days (January – February 2017)

    → **Flux variation > 250 kW/m²/s : 2 times in 30 days**

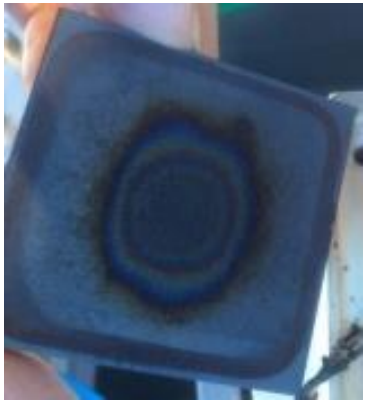
    Cycles applied with the SAAF : about 70 cycles /day

WP3 - Receiver Coating	**III/ First results : evolution of the absorptance**	PROMES

So far : 130 cycles applied on each sample

- **No visual damage on the coatings**

but oxidation of the steel substrate visible on the back of the selective sample



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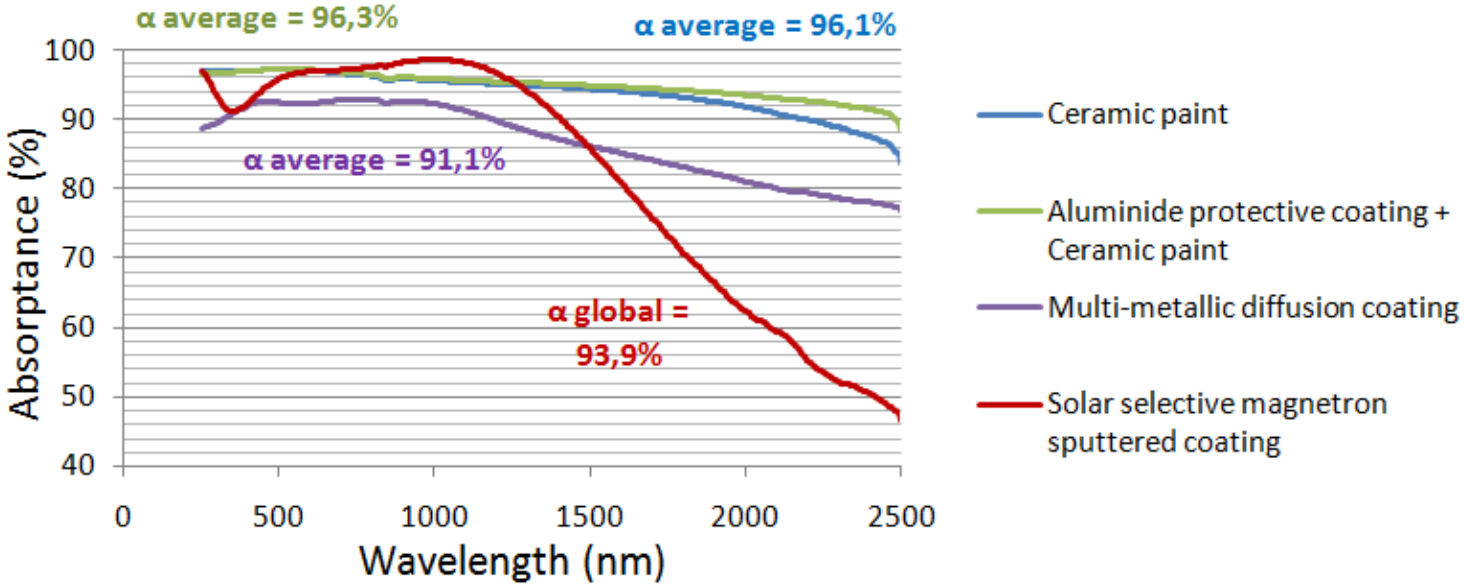

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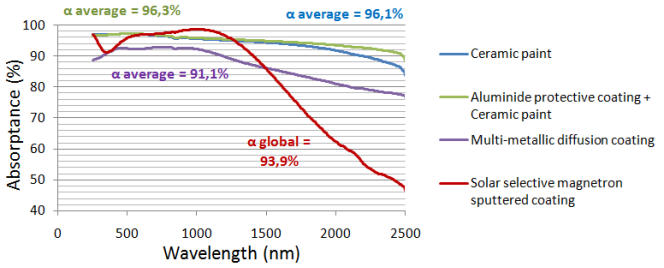
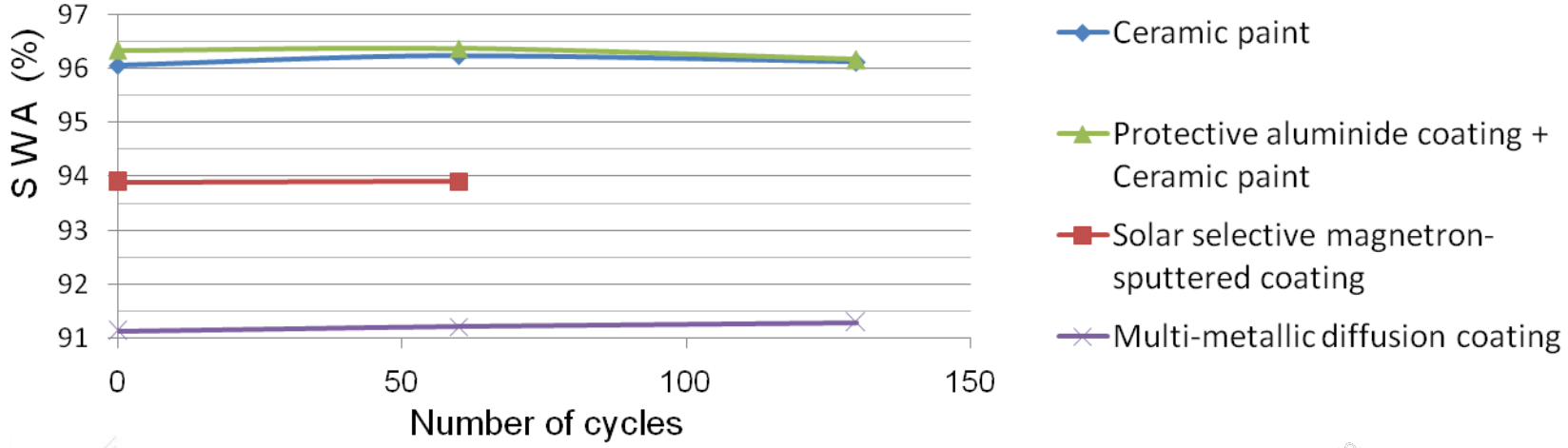


- **Spectral absorptance : stable**

- **Solar Weighted Absorptance : stable**



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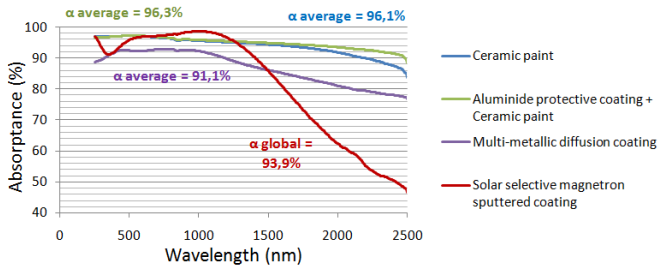
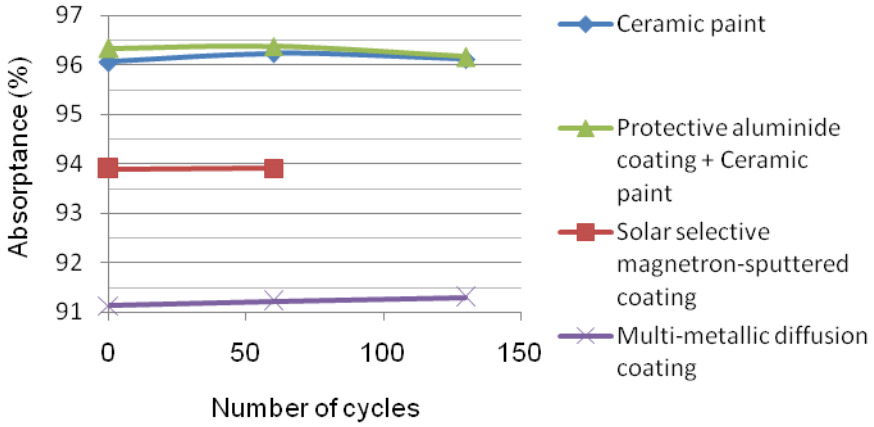


- **Solar Weighted Absorptance : stable**

No significative evolution of the absorptance with these kind of cycles for now



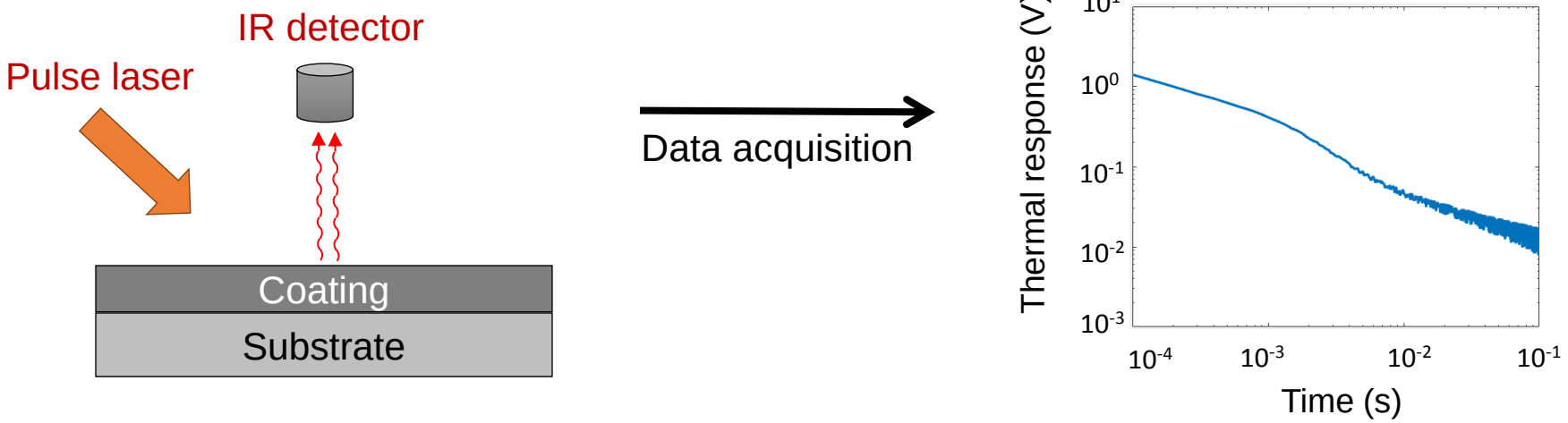
- More cycles ongoing, until 200 at least
- More aggressive tests ongoing

WP3 - Receiver Coating	**IV/ Other characterization expected : conductivity and diffusivity with photothermal experience**	PROMES

❑ Interesting characteristics

- Evolution of the coating **conductivity**
- Evolution of the coating **diffusivity**
- Evolution of the **Thermal Contact Resistance** between the coating and the substrate

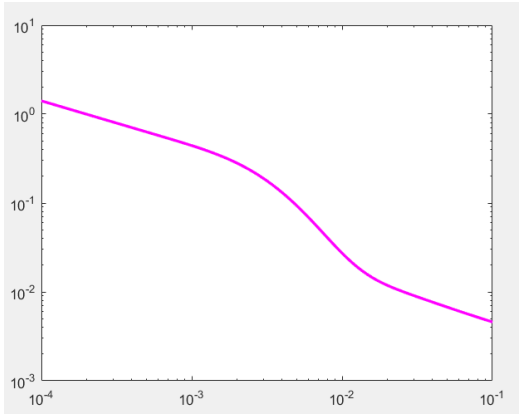
❑ Measuring test bench : photothermal device



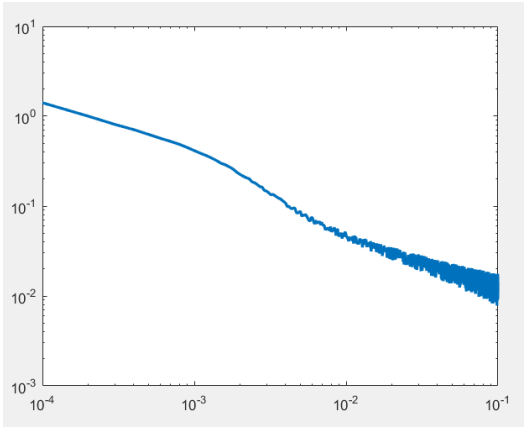
WP3 - Receiver Coating	**IV/ Other characterization expected : conductivity and diffusivity with photothermal experience**	PROMES

- **Use of the results to estimate the thermal characteristics β1, β2, β3**
  - **Inverse method**

Physical model of the experience :
T mod = f (β_{1i}, β_{2i}, β_{3i}, t)



Experimental evolution of the temperature :
T exp = g (t)



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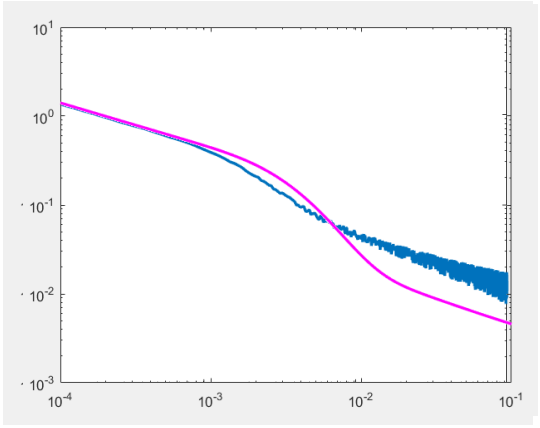
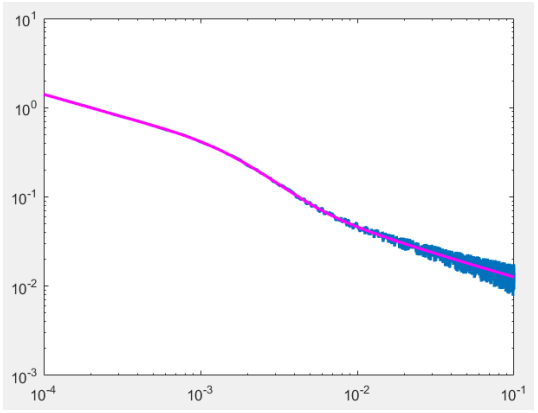
Minimization of the gap by **iteration** :
New values of the parameters β_1, β_2, β_3

Physical model of the experience :
$T_{mod} = f(\beta_{1i}, \beta_{2i}, \beta_{3i}, t)$



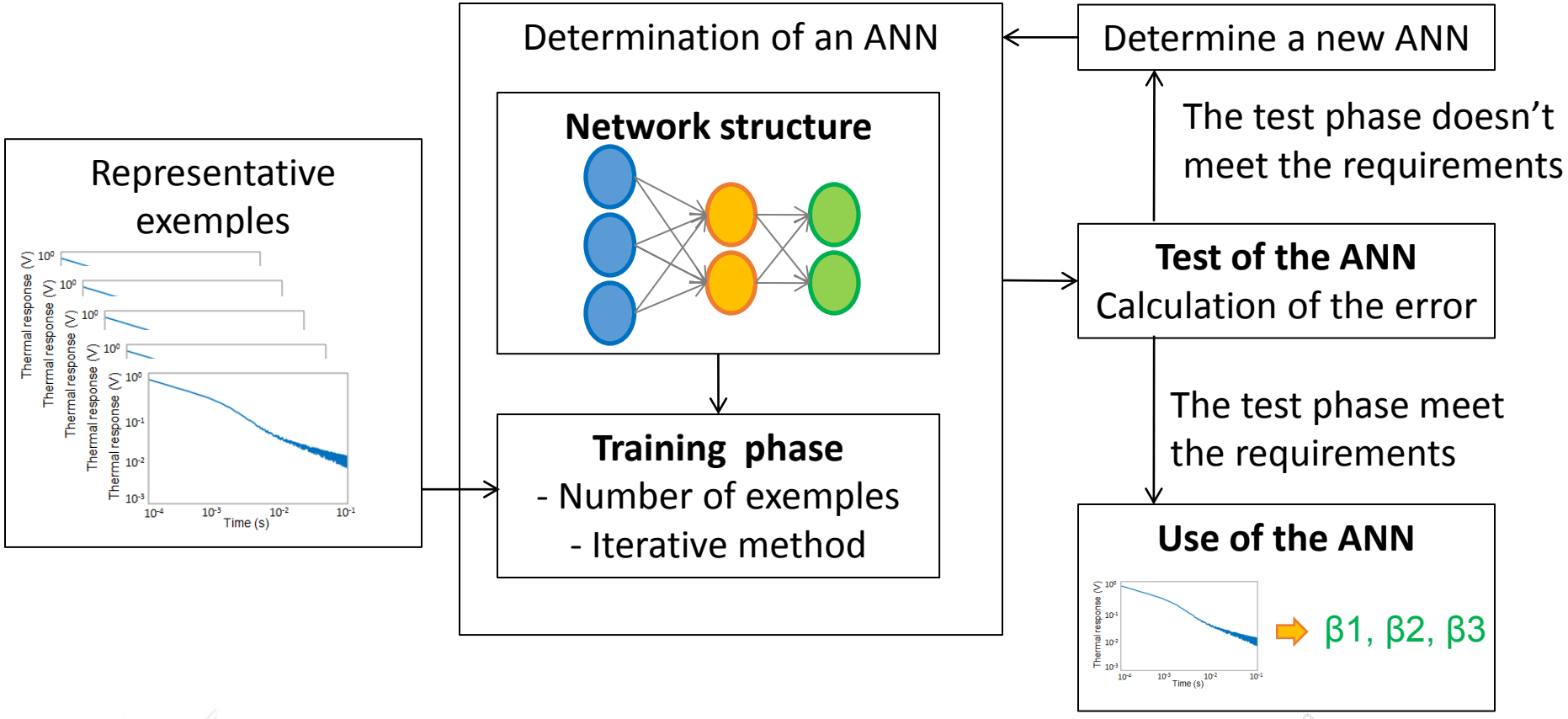


Experimental evolution of the temperature :
$T_{exp} = g(t)$

Adjusted parameters :
$T_{mod} = f(\beta_{1f}, \beta_{2f}, \beta_{3f}, t) = T_{exp} \pm \varepsilon$

WP3 - Receiver Coating	**IV/ Other characterization expected : conductivity and diffusivity with photothermal experience**	PROMES

- **Use of the results to estimate the thermal characteristics β1, β2, β3**
  - **Artificial Intelligence tools : Artificial Neural Network (ANN), connectionist approach**



Thank you for your attention

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