

**NIR-REFLECTIVE PROPERTIES OF PINK $\text{Al}_{1.95}\text{Cr}_{0.05}\text{O}_3$
PREPARED BY SOLUTION COMBUSTION SYNTHESIS**

**R. IANOȘ, E. MUNTEAN, R. BĂBUȚĂ, R. LAZĂU,
C. PĂCURARIU, C. BANDAS**



Step 1



Step 2



Step 3

Combustion
Synthesis

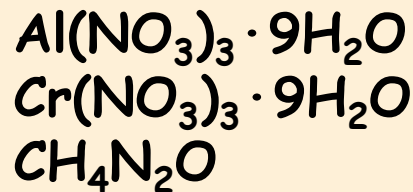
Characterization

NIR reflective
application



$\text{Al}_{1.95}\text{Cr}_{0.05}\text{O}_3$ Synthesis

Raw materials:



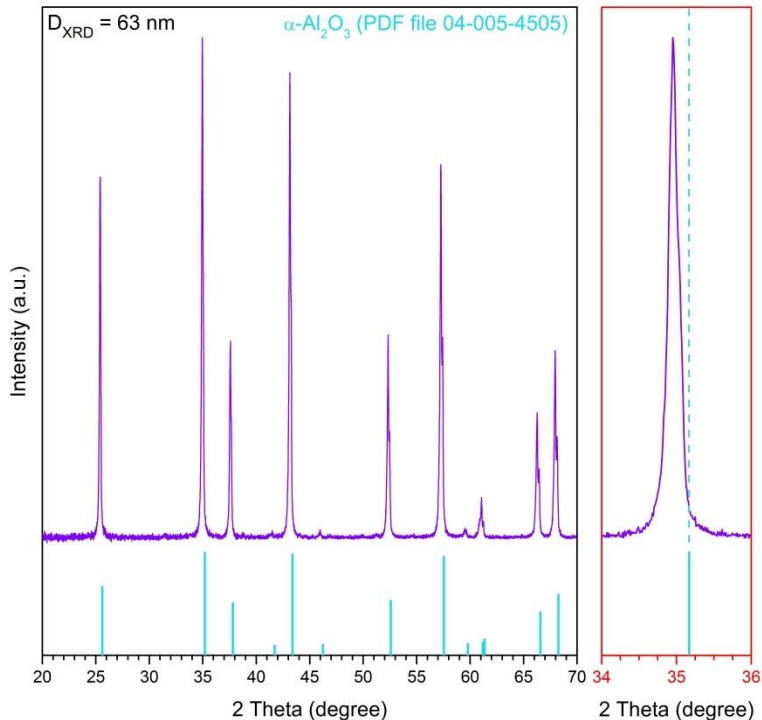
Green mixture

The ignition of the combustion reaction was achieved using a microwave oven operating at 800 W.

The sample after the microwave assisted combustion synthesis:



After 2 min started a powerful reaction that lasted 50 sec.



XRD pattern

single phase, as Ruby ($\text{Al}_2\text{O}_3:\text{Cr}$)

Diffraction peaks are moved to left due to the $\text{Al}^{3+} \rightarrow \text{Cr}^{3+}$ substitution

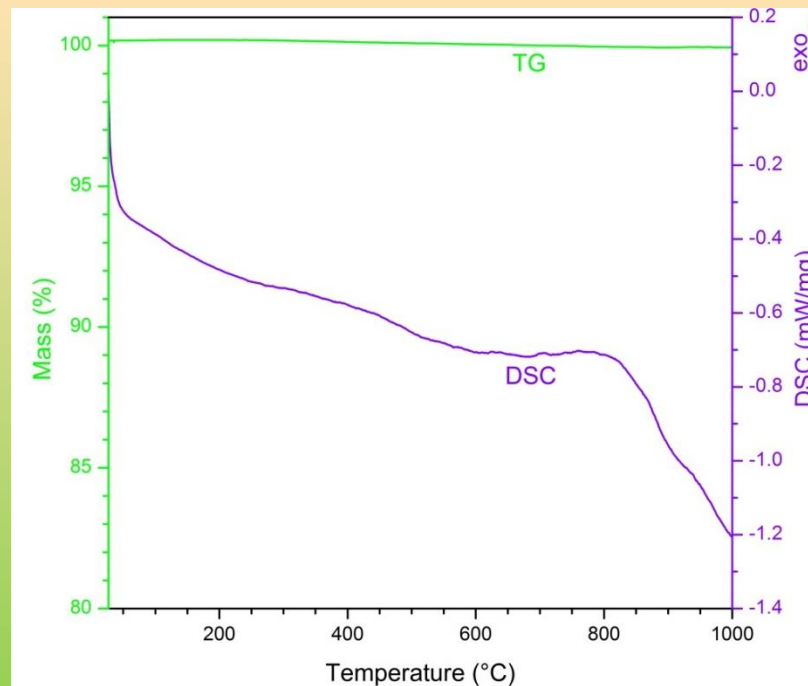
Cr^{3+} atomic radius is bigger than Al^{3+}

TG/DSC

No mass variation

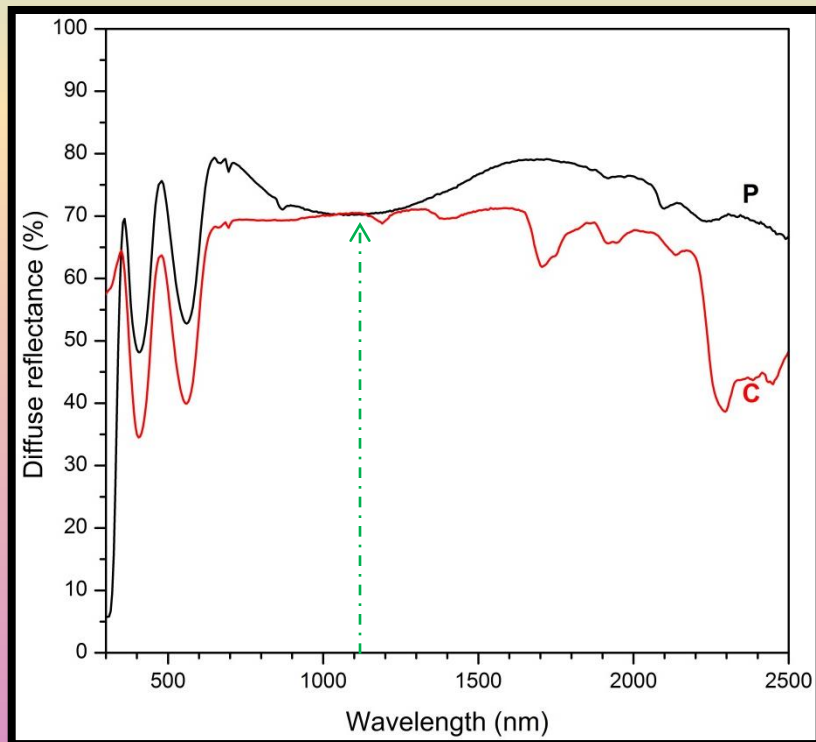
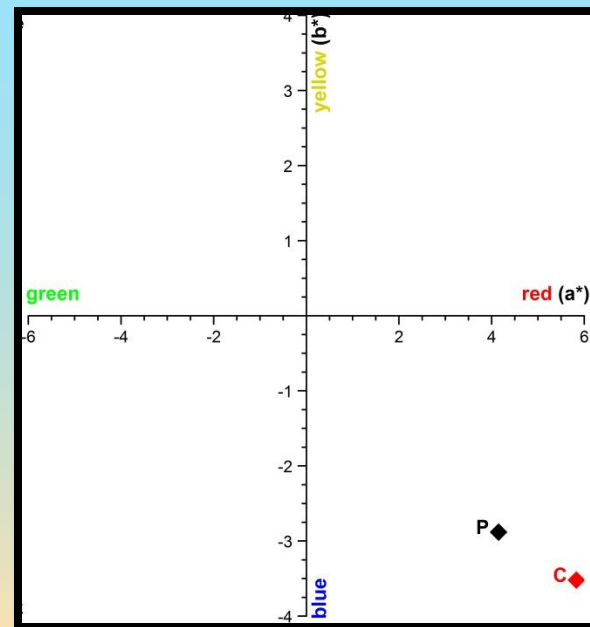
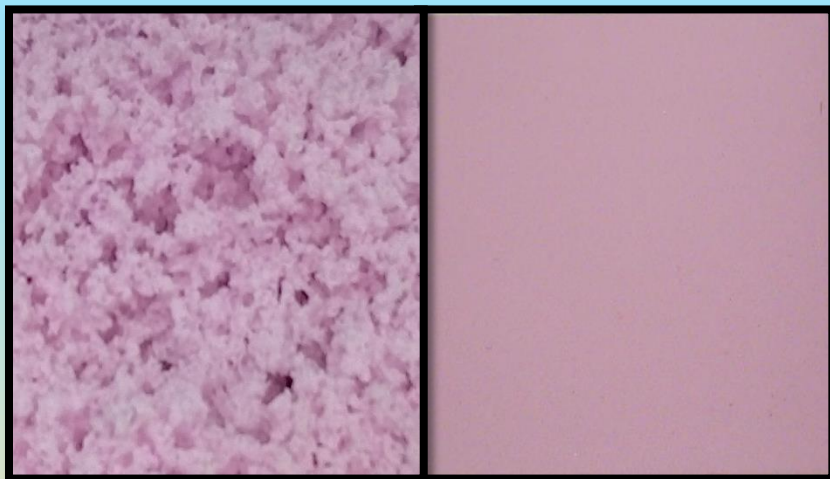


All the raw materials were transformed during the combustion synthesis.



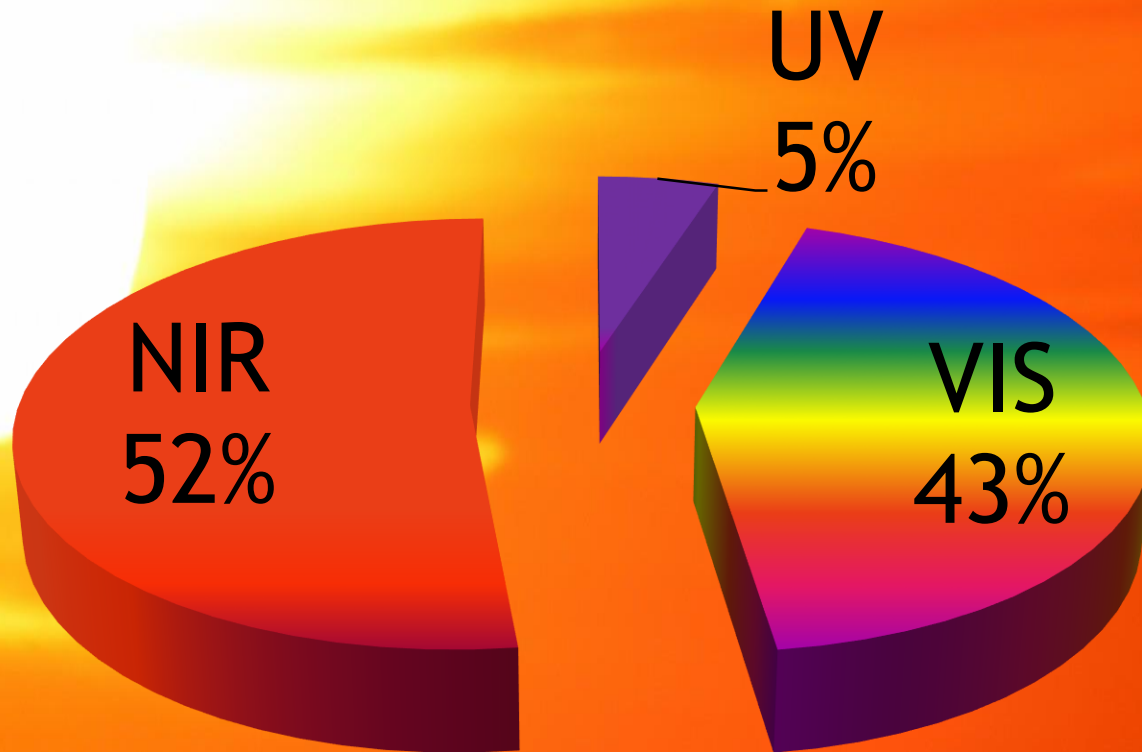
Pigment P

Coating C



Sample	L*	a*	b*
Pigment P	83.09	4.15	-2.88
Coating C	76.18	5.83	-3.52

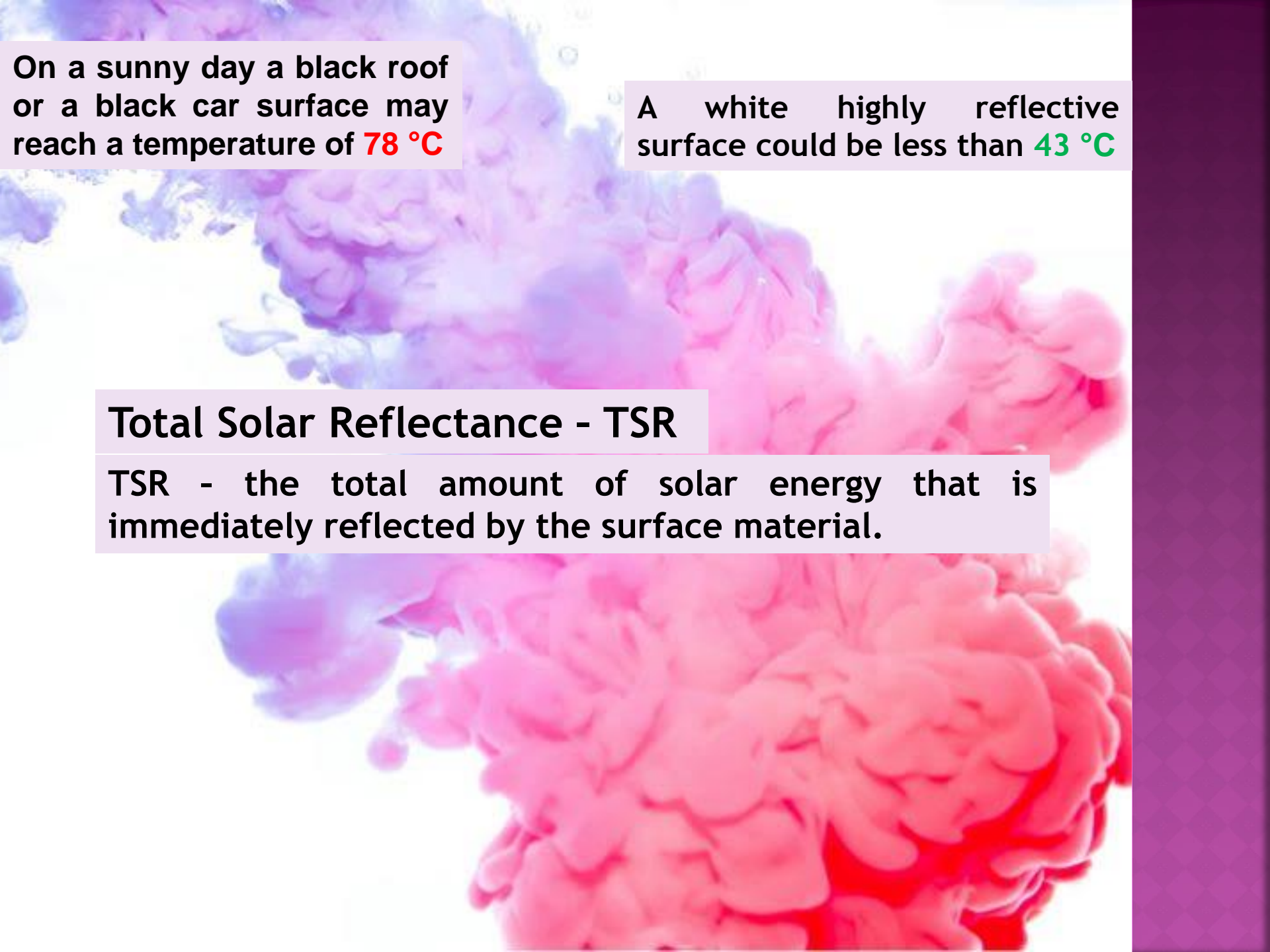
SOLAR ENERGY DISTRIBUTION



Ultraviolet - UV: 200 - 400 nm

Visible - VIS: 400 - 700 nm

Near infrared - NIR: 700 - 2500 nm → Felt as **HEAT**



On a sunny day a black roof
or a black car surface may
reach a temperature of **78 °C**

A white highly reflective
surface could be less than **43 °C**

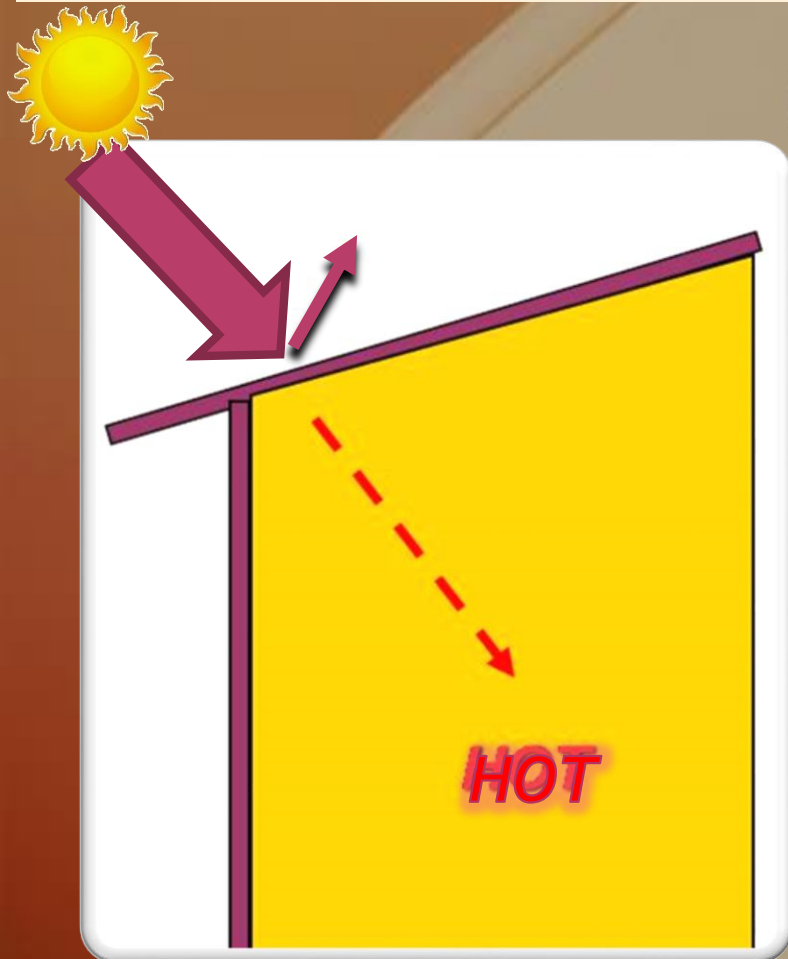
Total Solar Reflectance - TSR

TSR - the total amount of solar energy that is
immediately reflected by the surface material.

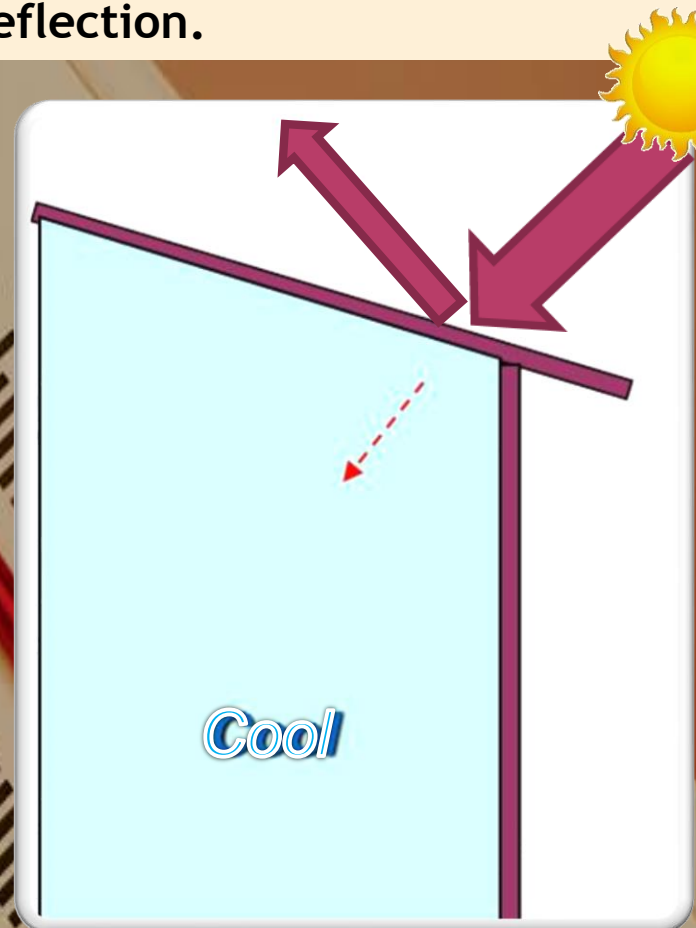
NIR REFLECTIVE COATING EFFECT

A low TSR shows a strong tendency to absorb NIR → significant heat!

A high TSR indicates efficient reflection.



Without coating



With coating

Water-based acrylic coating 20 % weight pigment
Aluminium sheet (60x60 mm)
Dried film had a thickness of 150 μm

W - white TiO_2 -based coating
C - the obtained pink pigment coating
B - black smoke based coating

W

C

B

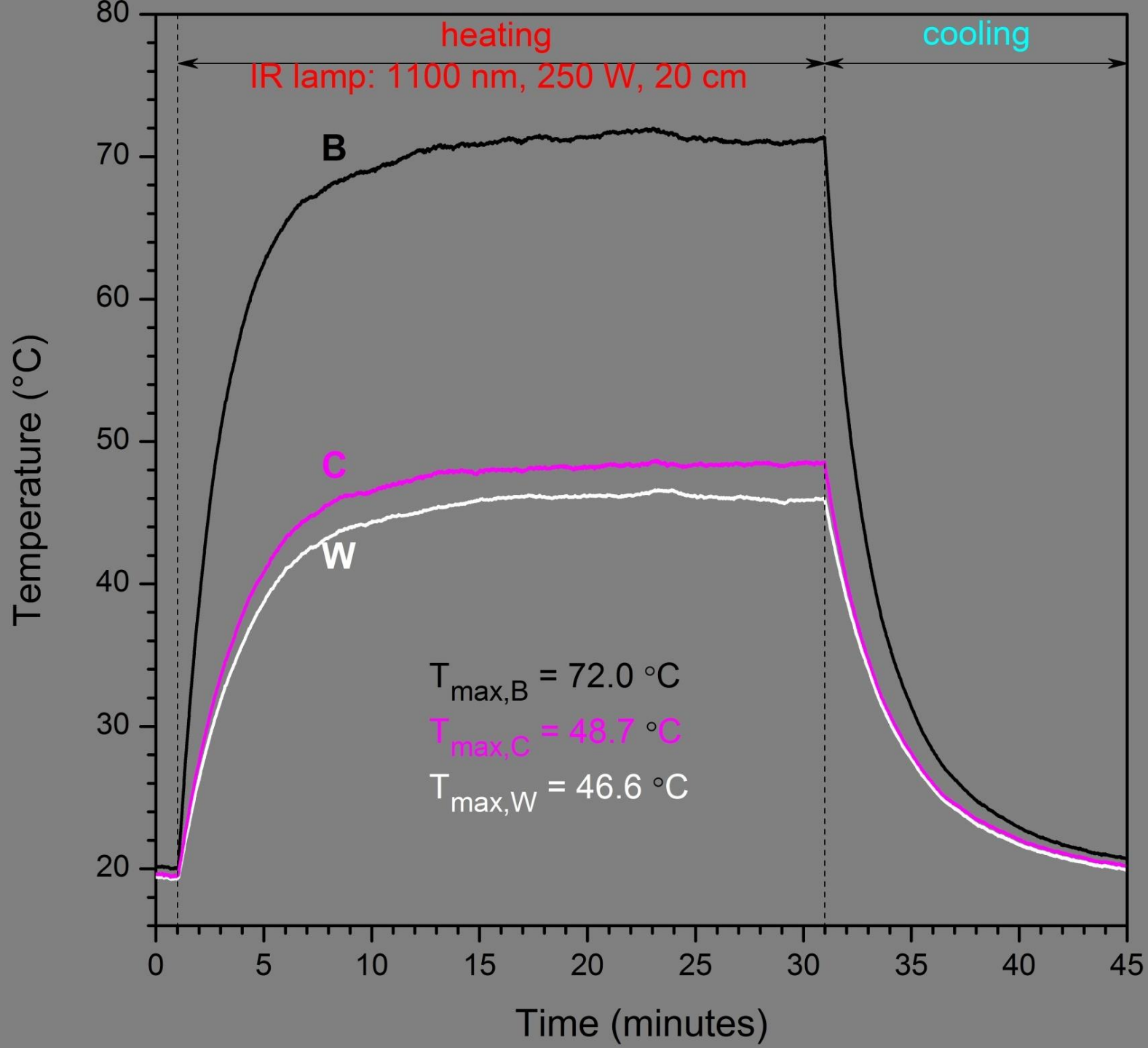


LABORATORY
SIMULATION

IR Lamp
1100 nm, 250 W

Heating for 30 min

FLIR T 640
High performance thermal
imaging visual camera, 15
frames/ sec.





CONCLUSIONS

$\text{Al}_{1.95}\text{Cr}_{0.05}\text{O}_3$ was obtained as single phase directly from the combustion

The resulted powder had a pink colour, according to the $L^*a^*b^*$ values

The pink pigment was successfully used in obtaining a NIR reflective coating

The laboratory simulation recommends the pink pigment (TSR 69.2%) and the coating (TSR 61.7%) for NIR reflective applications.



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Thank you!