10th Edition of symposium with international participation - New trends and strategies in the chemistry of advanced materials with relevance in biological systems, technique and environmental protection – June, 8-9, 2017

SINGLE-STEP SYNTHESIS OF $LaAl_{0.95}Cr_{0.05}O_3$ PIGMENTS AND THEIR NIR-REFLECTIVE PROPERTIES

Robert IANOȘ, Roxana BABUȚA, Radu LAZĂU, Eliza MUNTEAN, Cornelia PĂCURARIU, Anamaria DABICI, Elena Alina MOACĂ

Section A. SYNTHESIS

Section B. CHARACTERISATION

Section C. APPLICATION AS NIR PIGMENT/ COATING

Section A. SYNTHESIS

LA
$LaAlO_3$

LAC 0.05
$LaAl_{0.95}Cr_{0.05}O_3$

LAC 0.05F
$LaAl_{0.95}Cr_{0.05}O_3$ + 2%CaF_2

$LaAl_{0.95}Cr_{0.05}O_3$

Raw materials:
$La(NO_3)_3 \cdot 6H_2O$
$Al(NO_3)_3 \cdot 9H_2O$
$Cr(NO_3)_3 \cdot 9H_2O$
CaF_2
CH_4N_2O
$C_2H_5NO_2$

COMBUSTION

Pre-heated mantle
at 400 °C

LA

$$6\ La(NO_3)_3 + 10\ C_2H_5NO_2 + 6\ Al(NO_3)_3 + 15\ CH_4N_2O = 6\ LaAlO_3 + 35\ CO_2 + 55\ H_2O + 38\ N_2$$

LAC 0.05

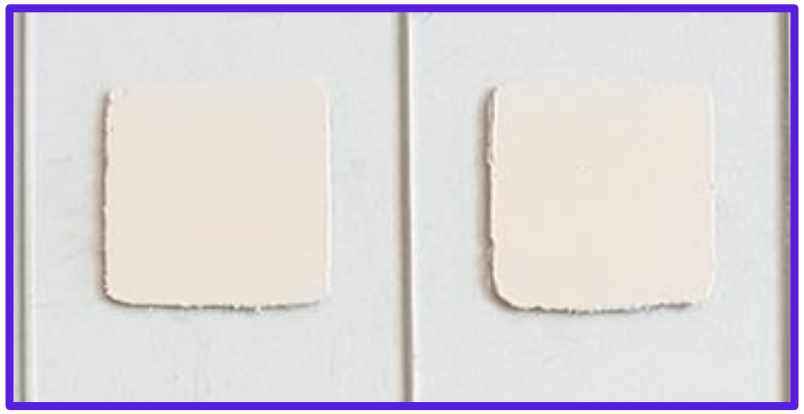
$$6\ La(NO_3)_3 + 10\ C_2H_5NO_2 + 5.7\ Al(NO_3)_3 + 0.3\ Cr(NO_3)_3 + 15\ CH_4N_2O =$$
$$= 6\ LaAl_{0.95}Cr_{0.05}O_3 + 35\ CO_2 + 55\ H_2O + 38\ N_2$$

LAC 0.05 F (CaF_2 2%)

$$6\ La(NO_3)_3 + 10\ C_2H_5NO_2 + 5.7\ Al(NO_3)_3 + 0.3\ Cr(NO_3)_3 + 15\ CH_4N_2O =$$
$$= 6\ LaAl_{0.95}Cr_{0.05}O_3 + 35\ CO_2 + 55\ H_2O + 38\ N_2$$

LA
$LaAlO_3$

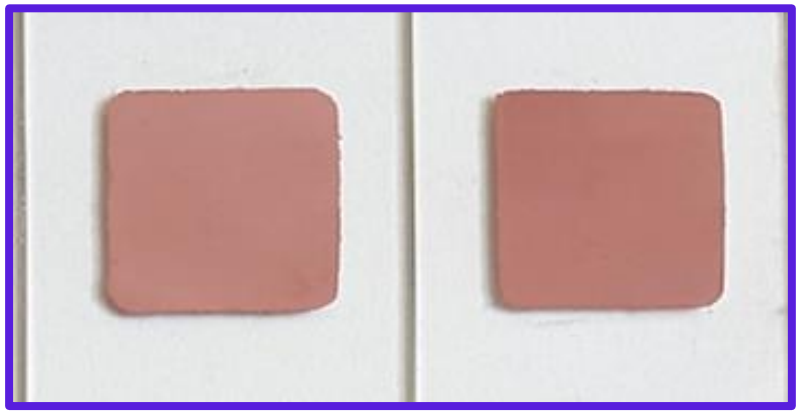
LAC 0.05
$LaAl_{0.95}Cr_{0.05}O_3$



COMBUSTION

1200 °C/ 1h

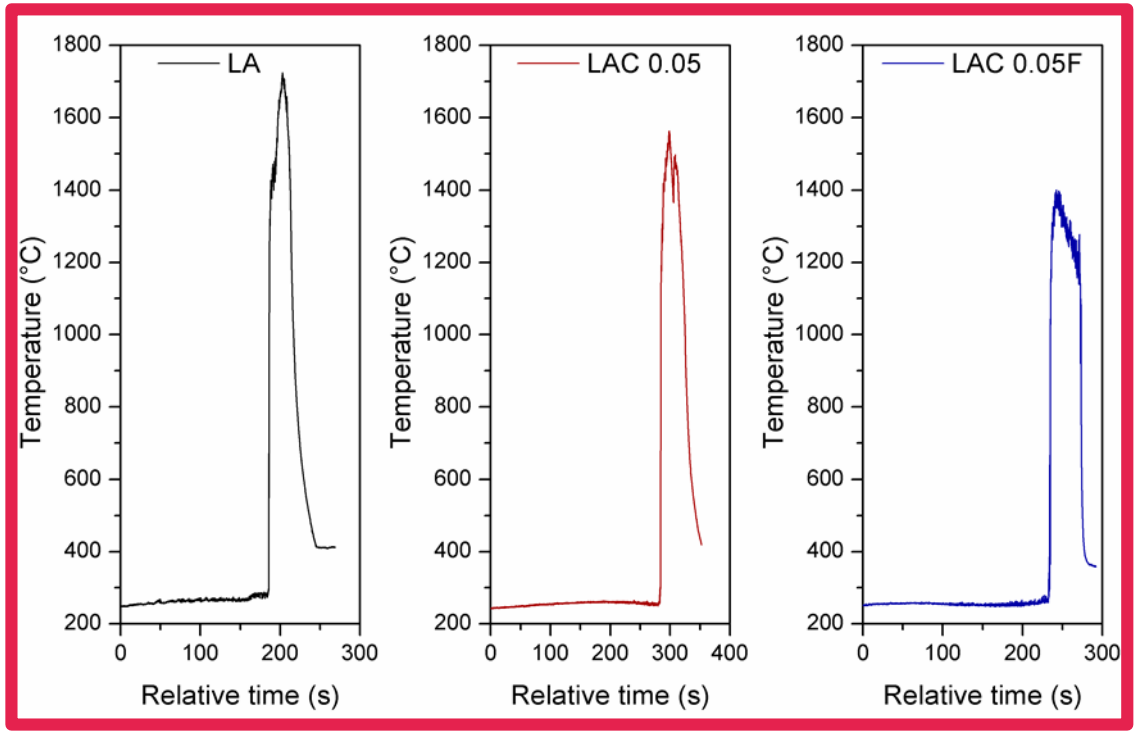
LAC 0.05F
$LaAl_{0.95}Cr_{0.05}O_3$ + 2%CaF_2



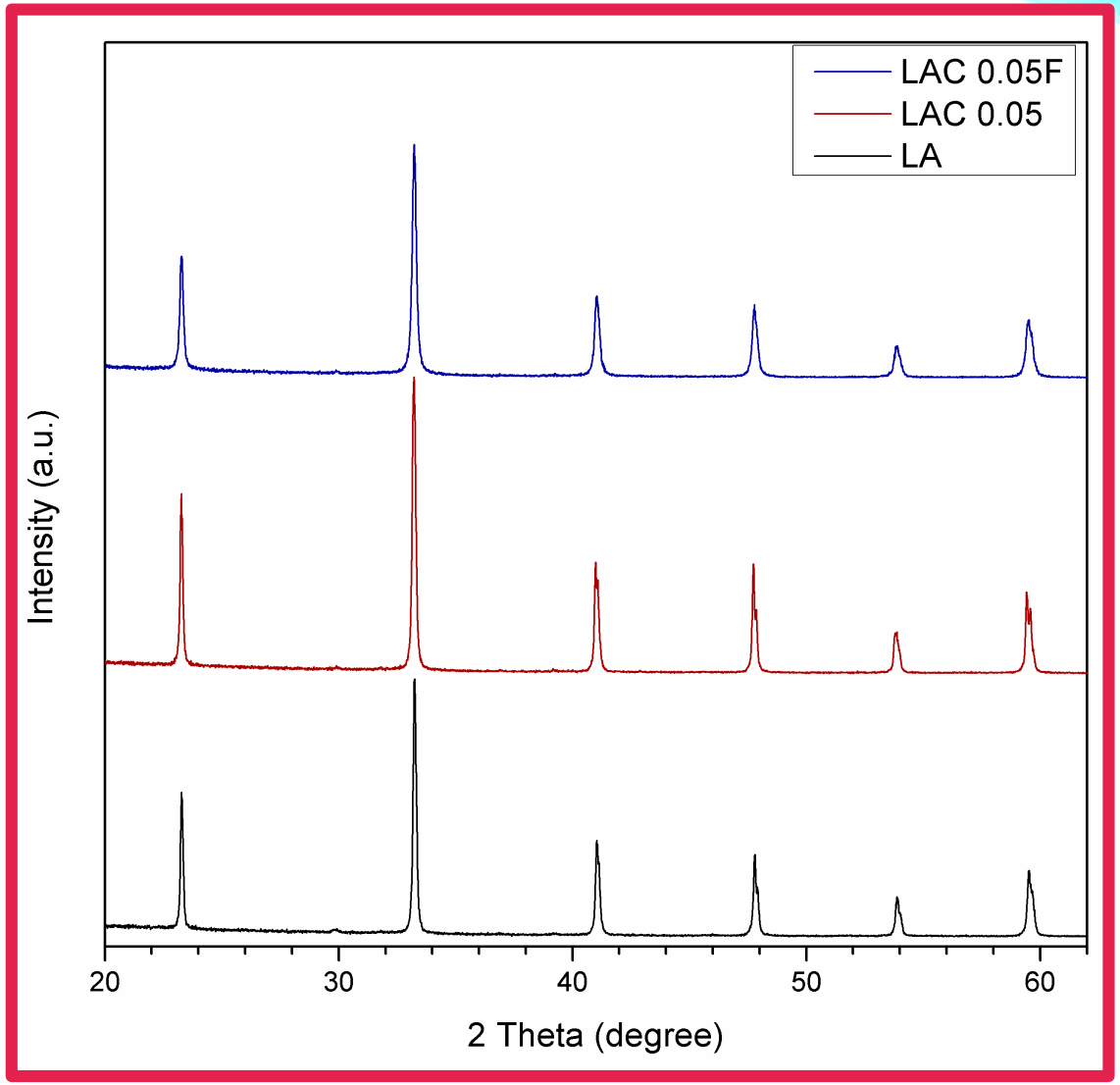
COMBUSTION

1200 °C/ 1h

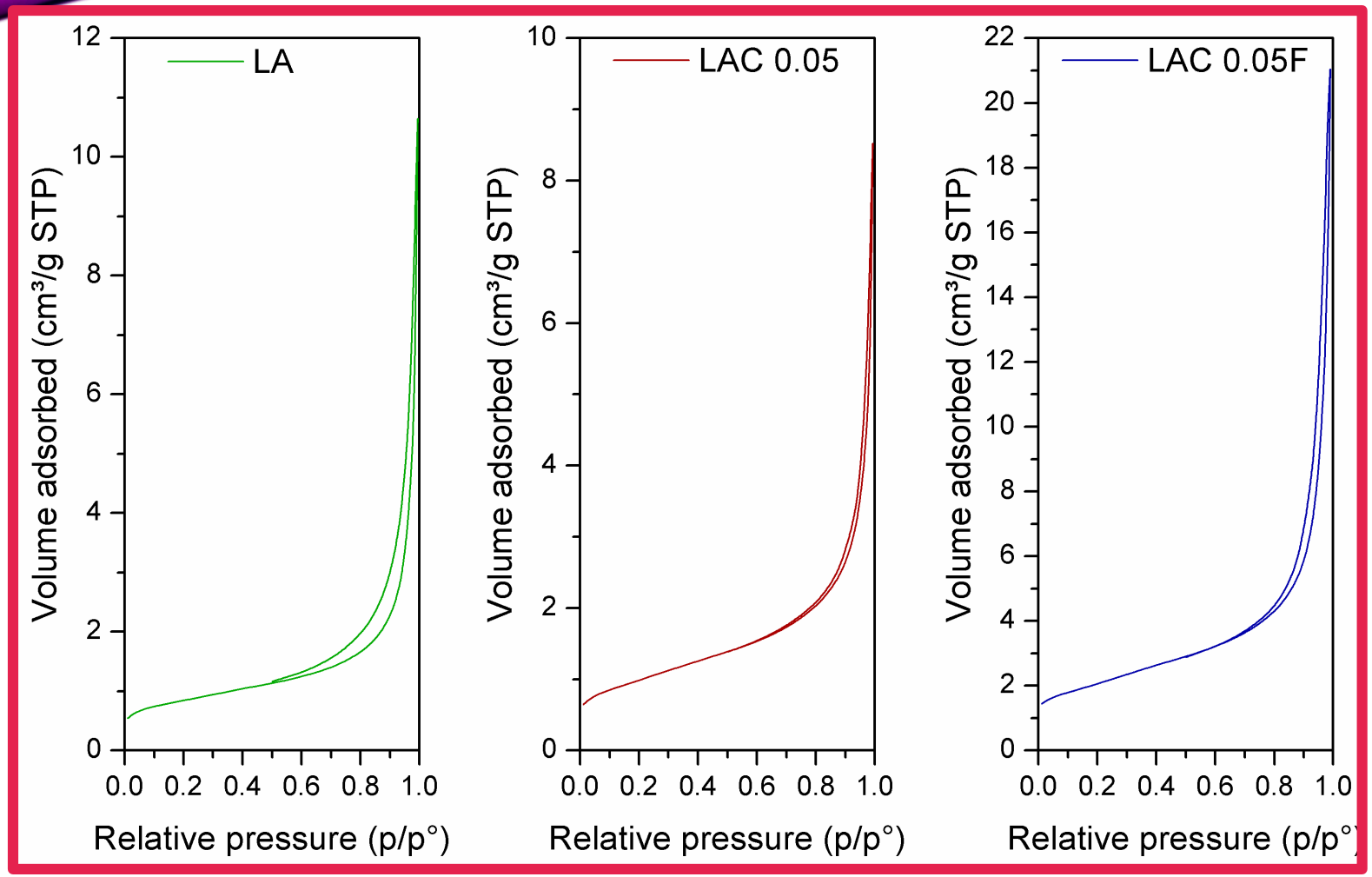
Section B. CHARACTERISATION



Measured temperature during combustion



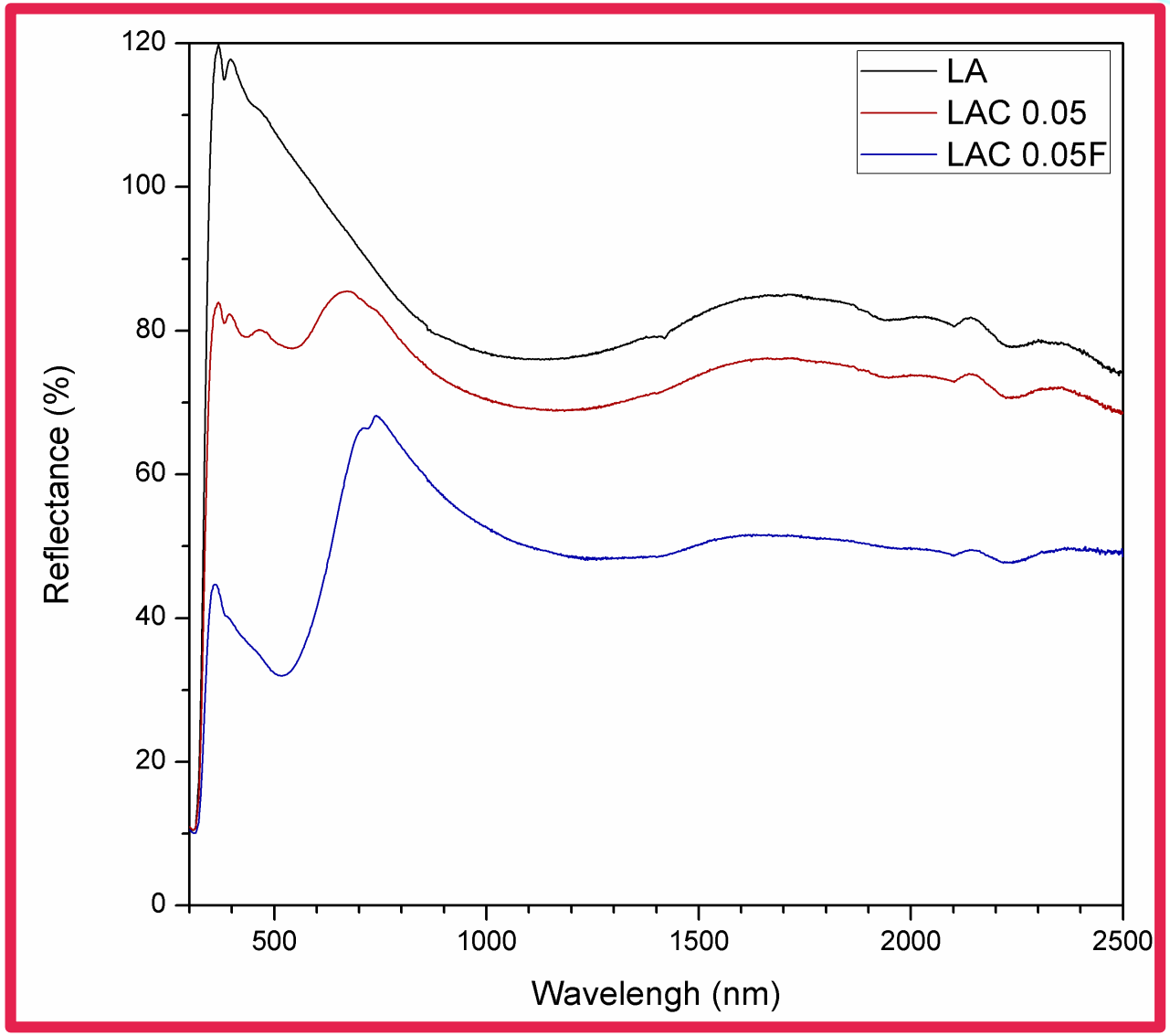
XRD pattern of the sample resulted from the combustion reaction
PDF card 031-0022



	S_{BET} (m^2/g)	D_{XRD} (nm) peak 100%
LA	3.0	71
LAC 0.05	3.5	64
LAC 0.05 F	7.3	51

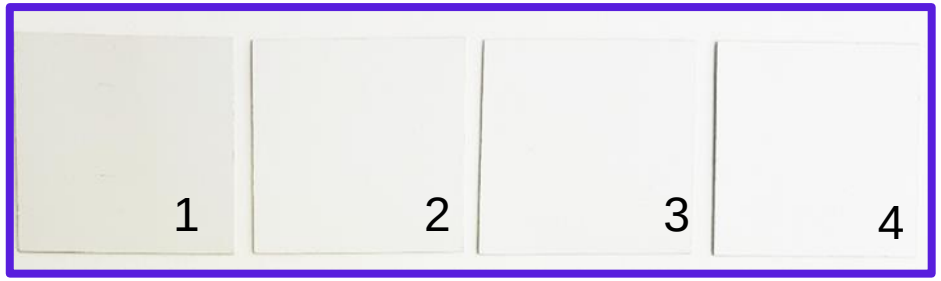
Adsorption-desorption isotherms of the combustion-synthesized sample

Sample	TSR (%)	L*	a*	b*
LA	**91.9**	97.96	0.27	1.84
LAC 0.05	**77.1**	88.69	4.76	5.22
LAC 0.05 F	**48.5**	59.32	16.73	6.50



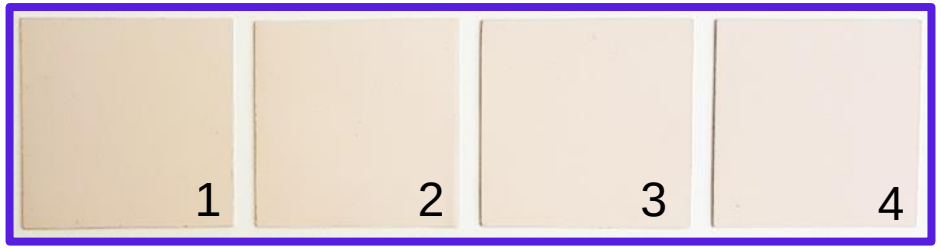
Section C. APPLICATION AS NIR PIGMENT/ COATING

LA



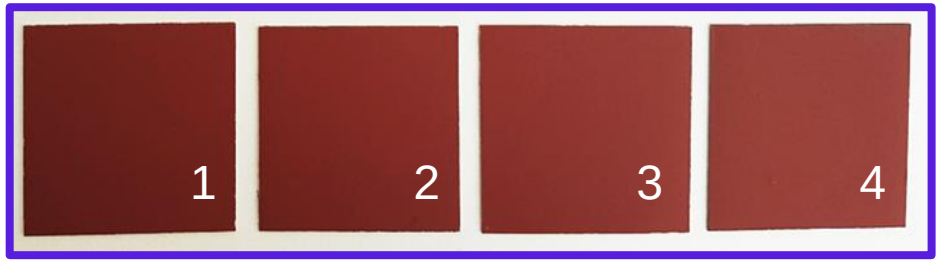
Water-based acrylic coating
30 % weight pigment

LAC 0.05

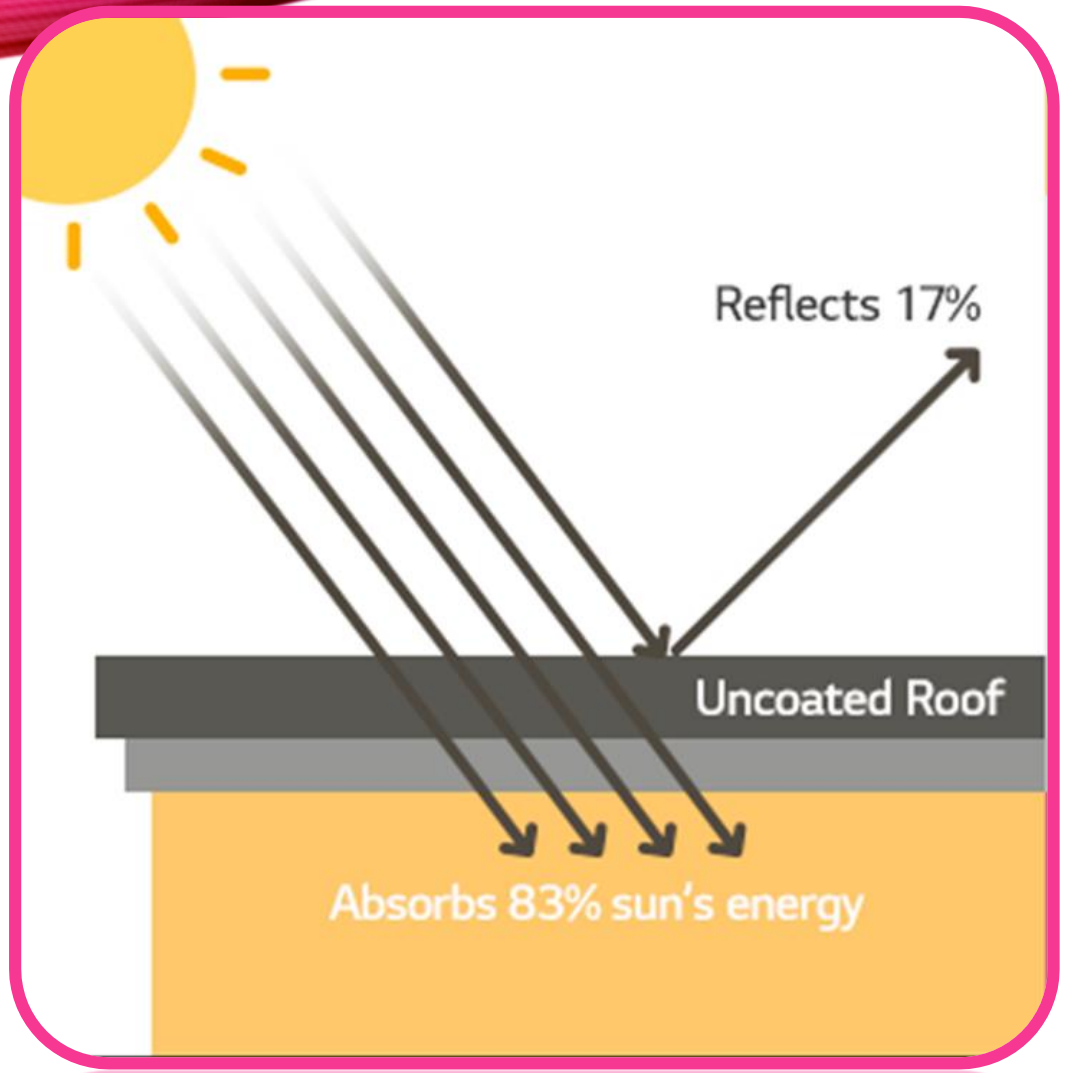


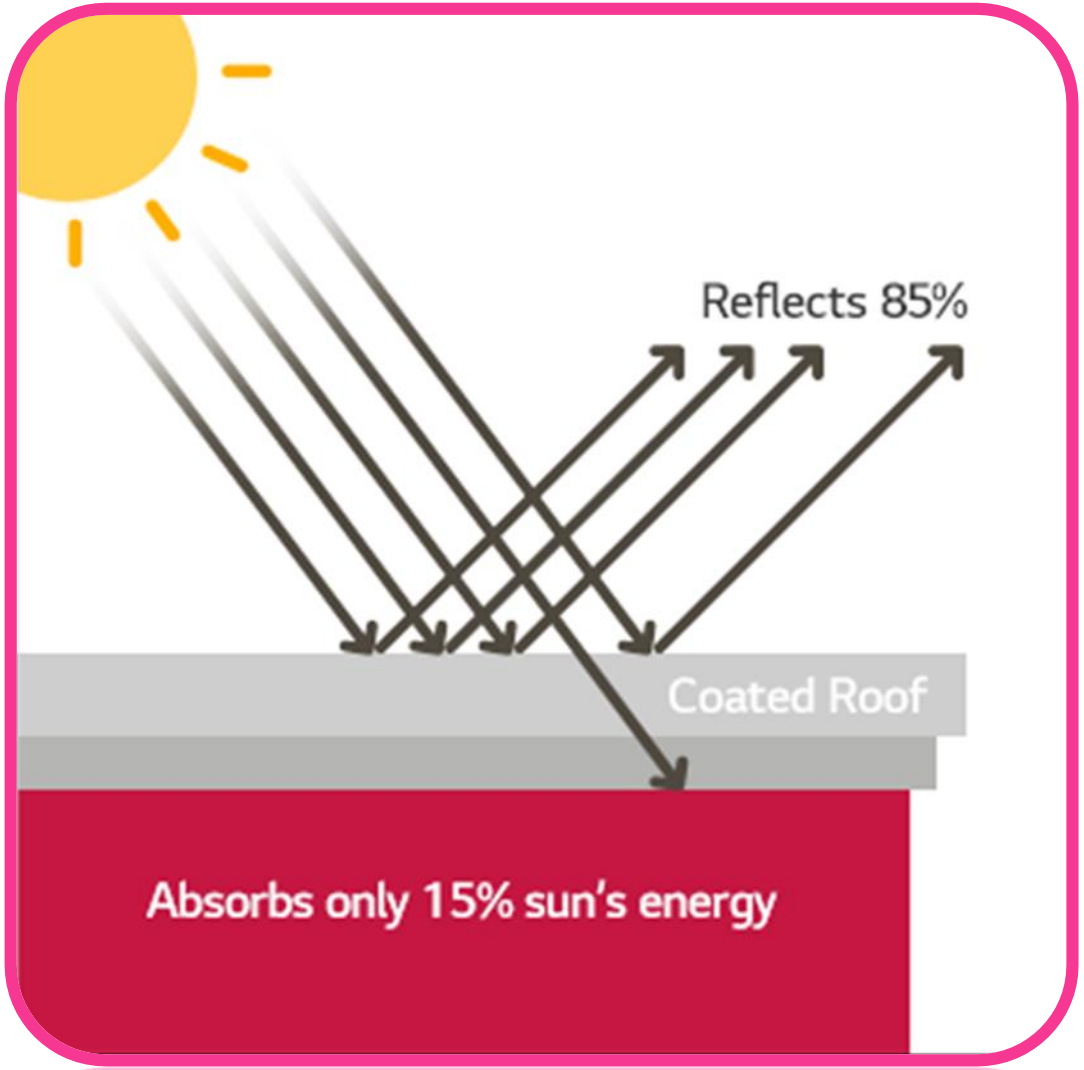
1 - 1 layer 100 µm
2 – 1 layer 200 µm
3 – 1 layer 300 µm
4 – 2 layer 300 µm

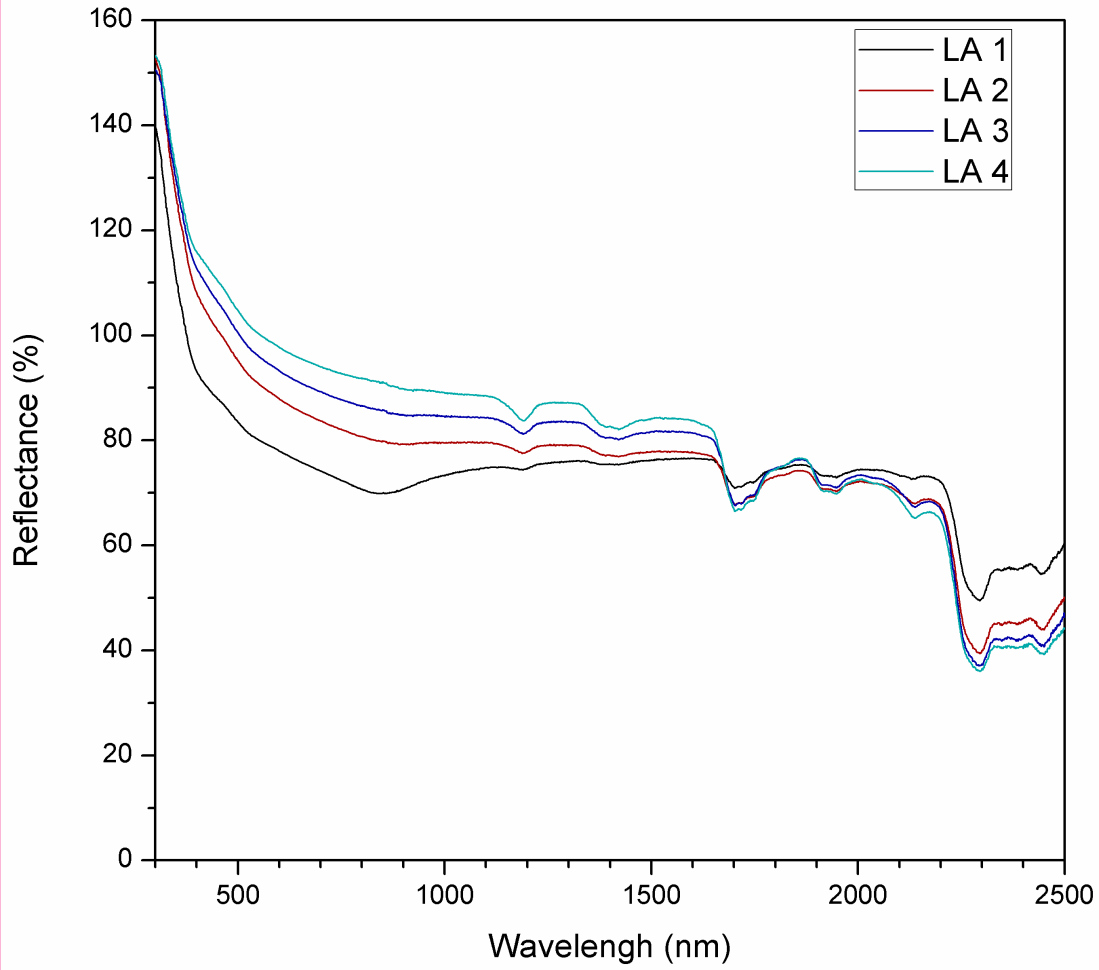
LAC 0.05F



NIR PIGMENT/ COATING

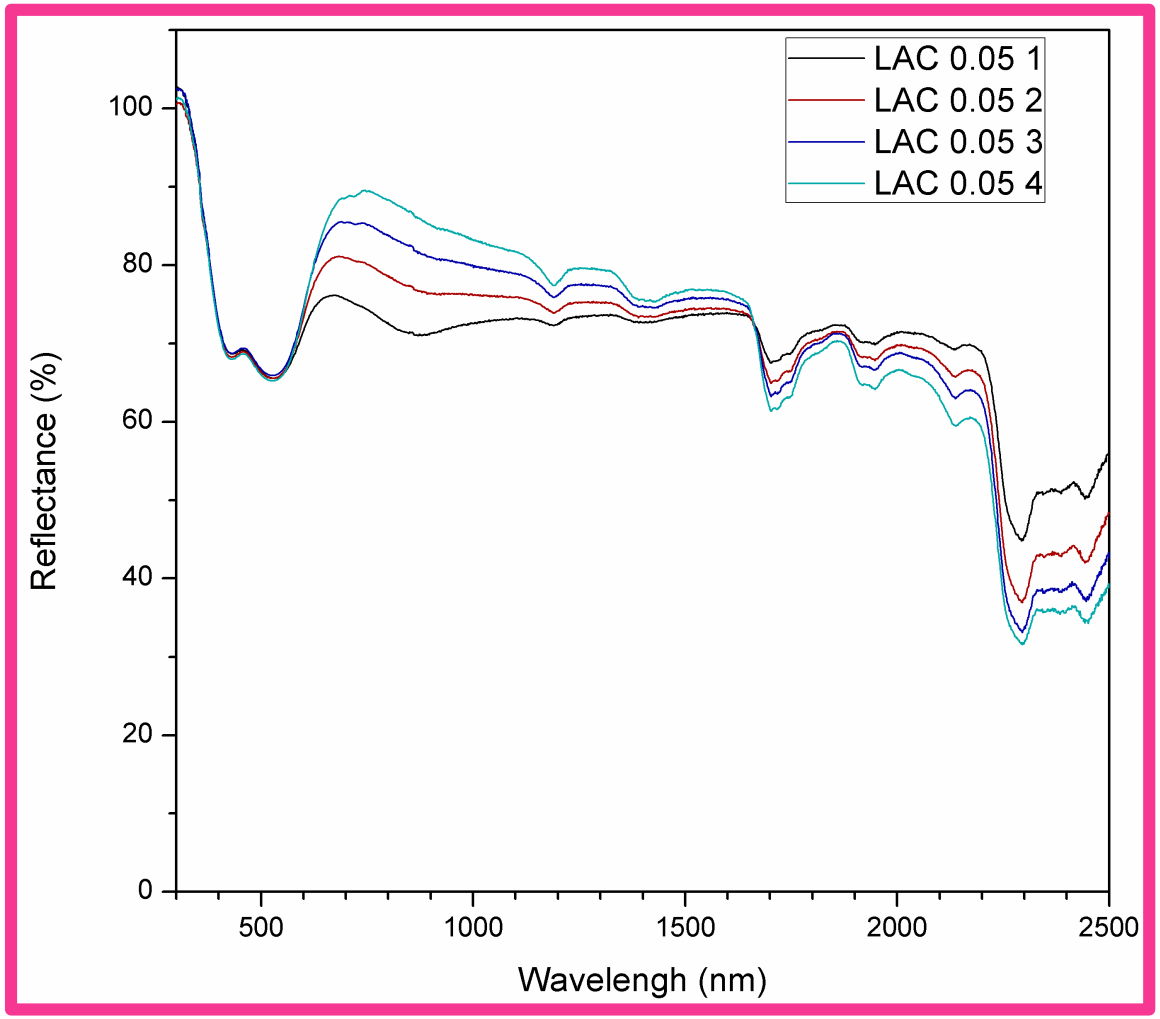


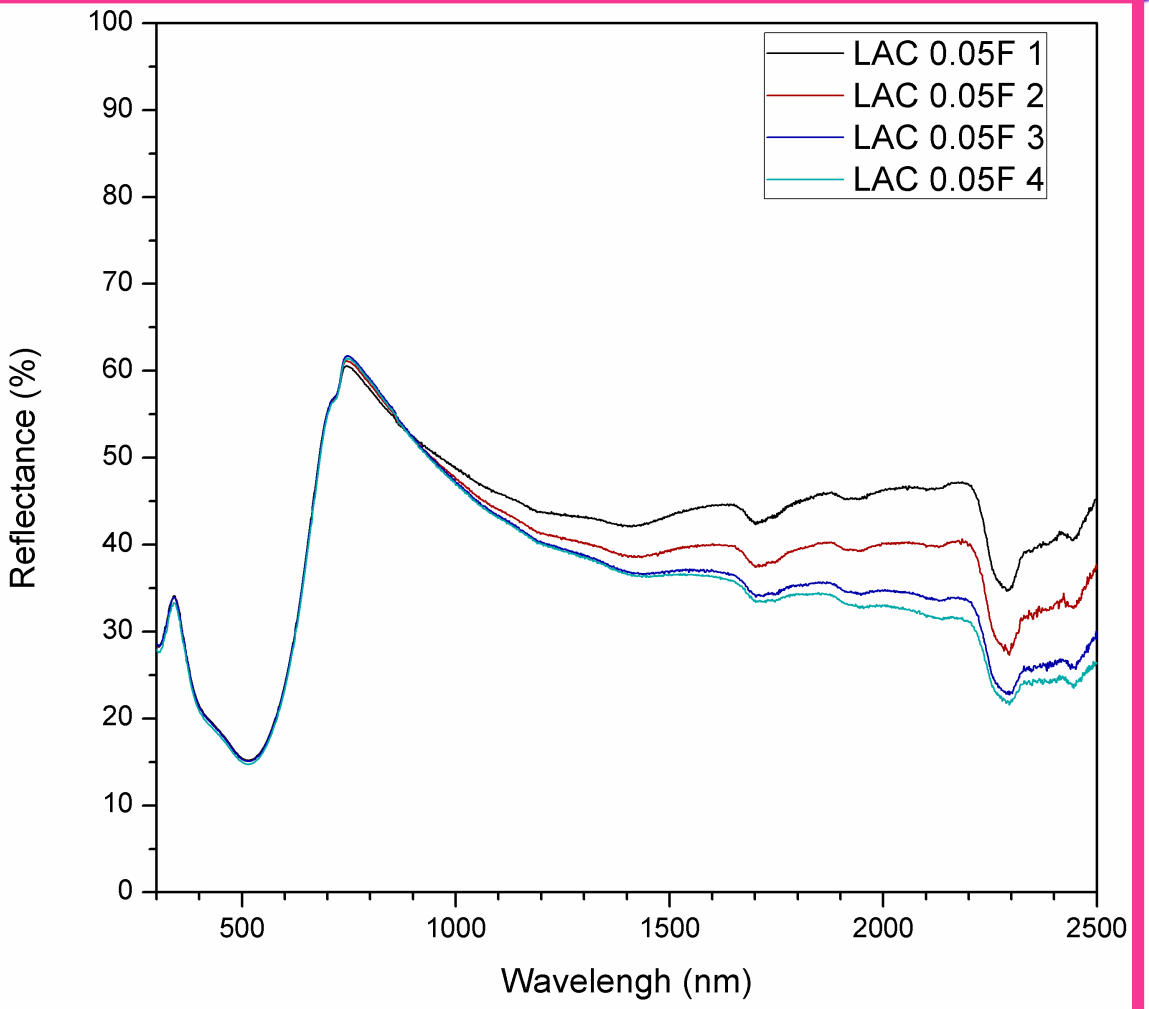




Sample	TSR	L*	a*	b*
LA 1	78.0	91.04	-0.09	0.87
LA 2	86.4	95.65	-0.20	0.02
LA 3	91.2	97.61	-0.12	0.43
LA 4	95.1	99.52	-0.02	0.91

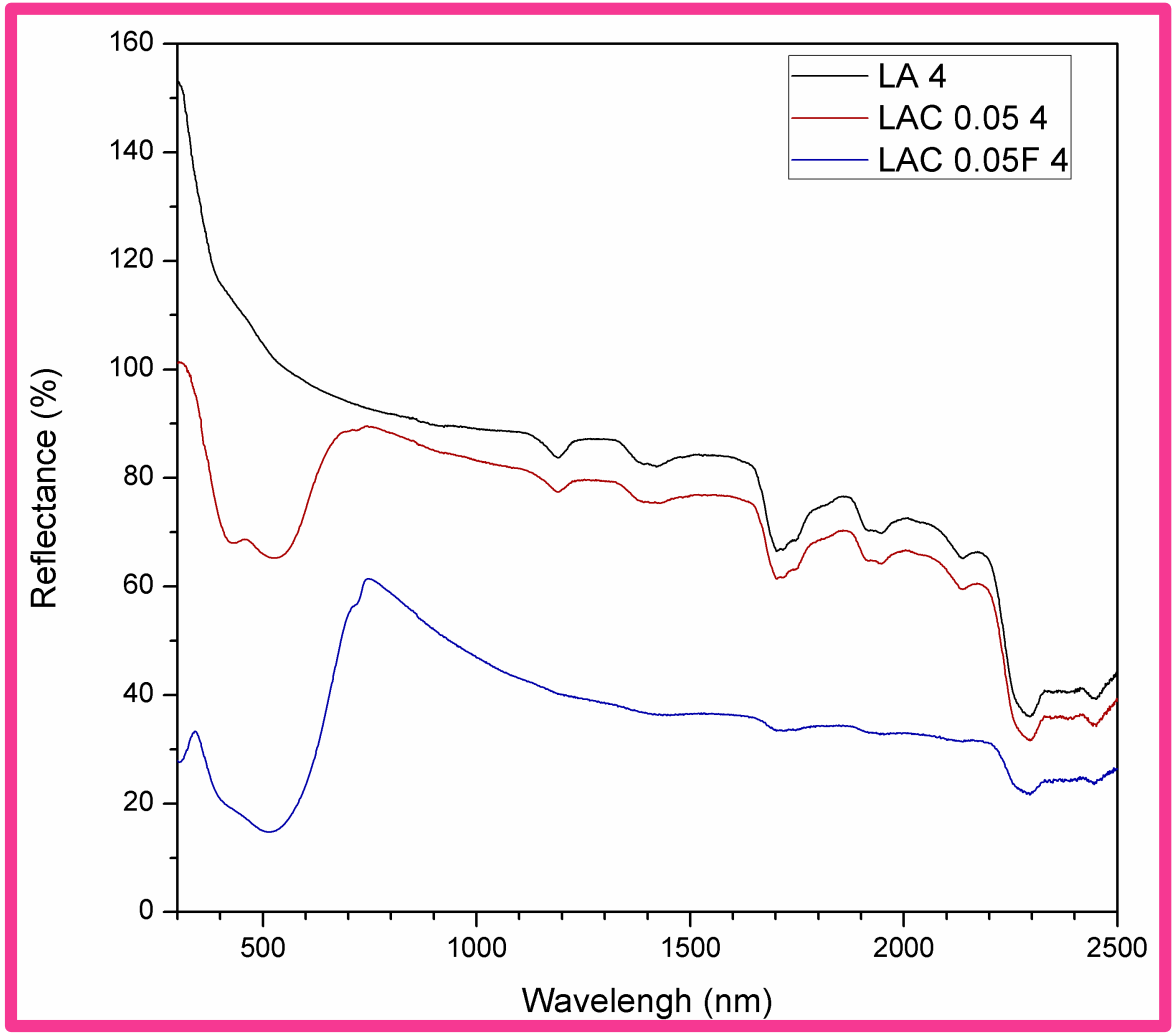
Sample	TSR	L*	a*	b*
LAC 0.05 1	71.8	85.16	5.07	5.42
LAC 0.05 2	74.0	85.24	6.26	6.30
LAC 0.05 3	76.2	85.65	7.09	6.42
LAC 0.05 4	77.5	85.40	7.59	6.62





Sample	TSR	L*	a*	b*
LAC 0.05F 1	37.8	50.31	17.14	6.15
LAC 0.05F 2	36.9	50.09	17.22	6.22
LAC 0.05F 3	36.4	50.02	17.05	6.11
LAC 0.05F 4	36.0	49.67	17.15	6.22

Sample	L*	a*	b*
LA 4	99.52	-0.02	0.91
LAC 0.05 4	85.40	7.59	6.62
LAC 0.05F 4	49.67	17.15	6.22



CONCLUSIONS

$LaAl_{1.95}Cr_{0.05}O_3$ was obtained as single phase directly from the combustion.

CaF_2 as a mineralization agent intensified the color from light pink to dark red.

For all the powders and the coatings were recorded the L*a*b* values.

The pigments were successfully used in obtaining NIR reflective coatings.

The preliminary test recommends the pigments and the coatings for NIR reflective applications.

This work was supported by a grant of the Romanian National Authority for Scientific Research and Innovation, CNCS – UEFISCDI, project number PN-II-RU-TE-2014-4-1587.

Thank you!