Optimisation of optical absorption properties of spectrally selective C-NiO composite coatings

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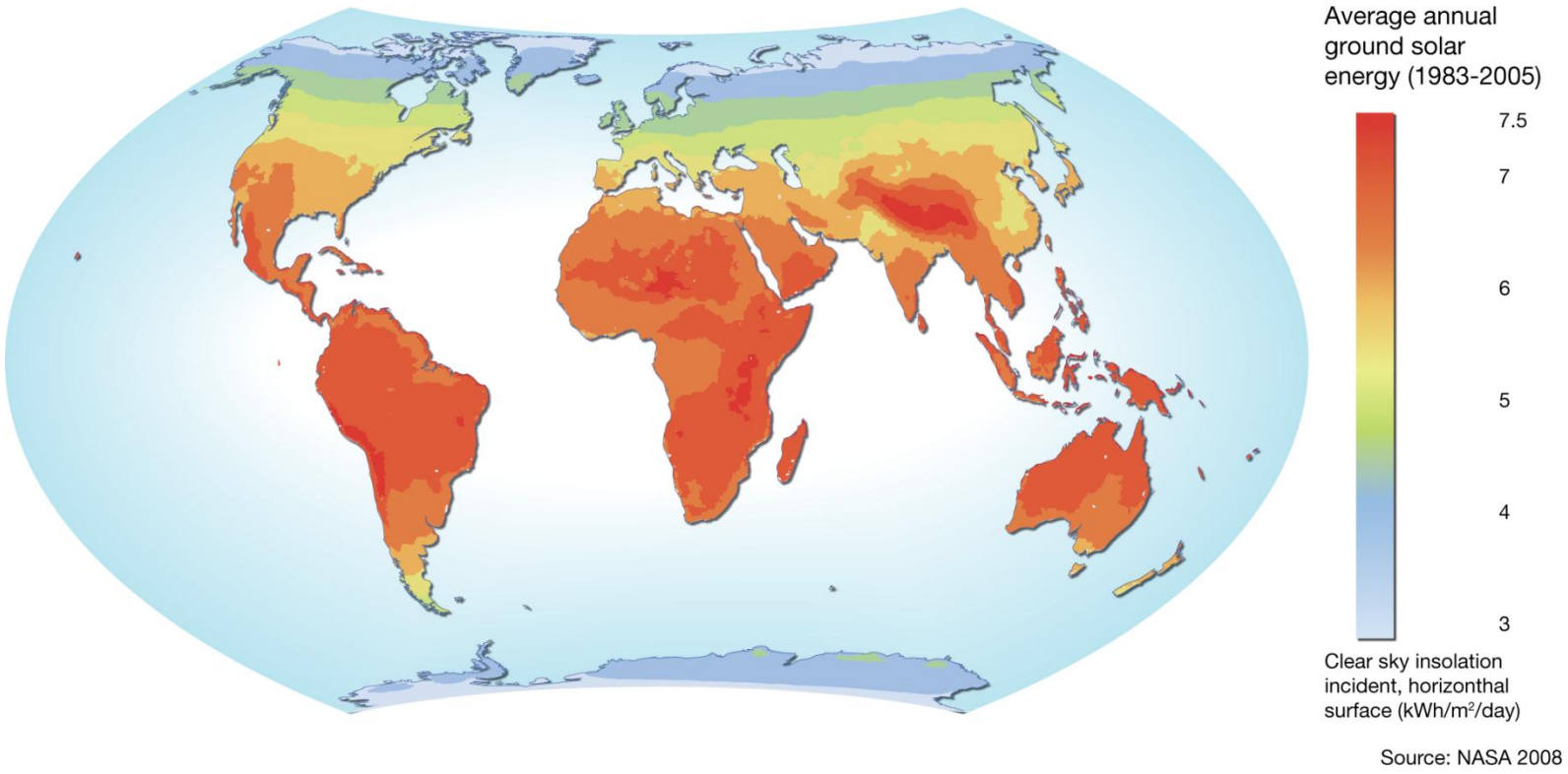
our future through science

Fire wood is the traditional fuel in most rural Africa

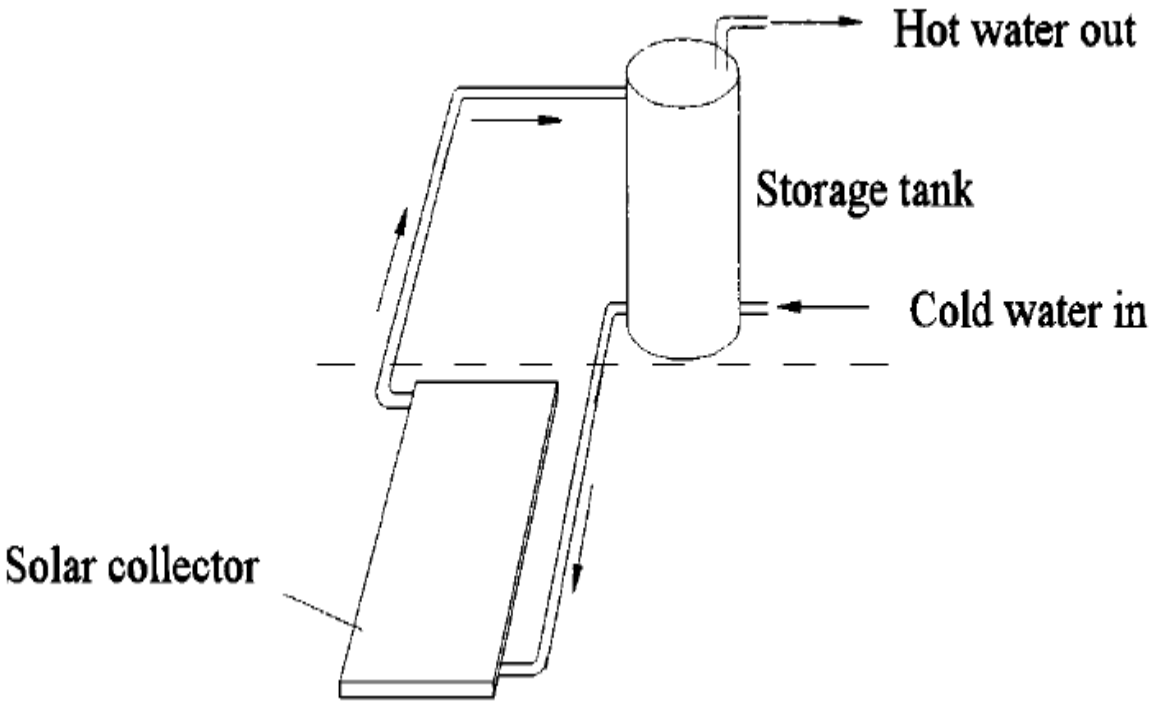
Most African countries have ~ 325 days of strong sunlight



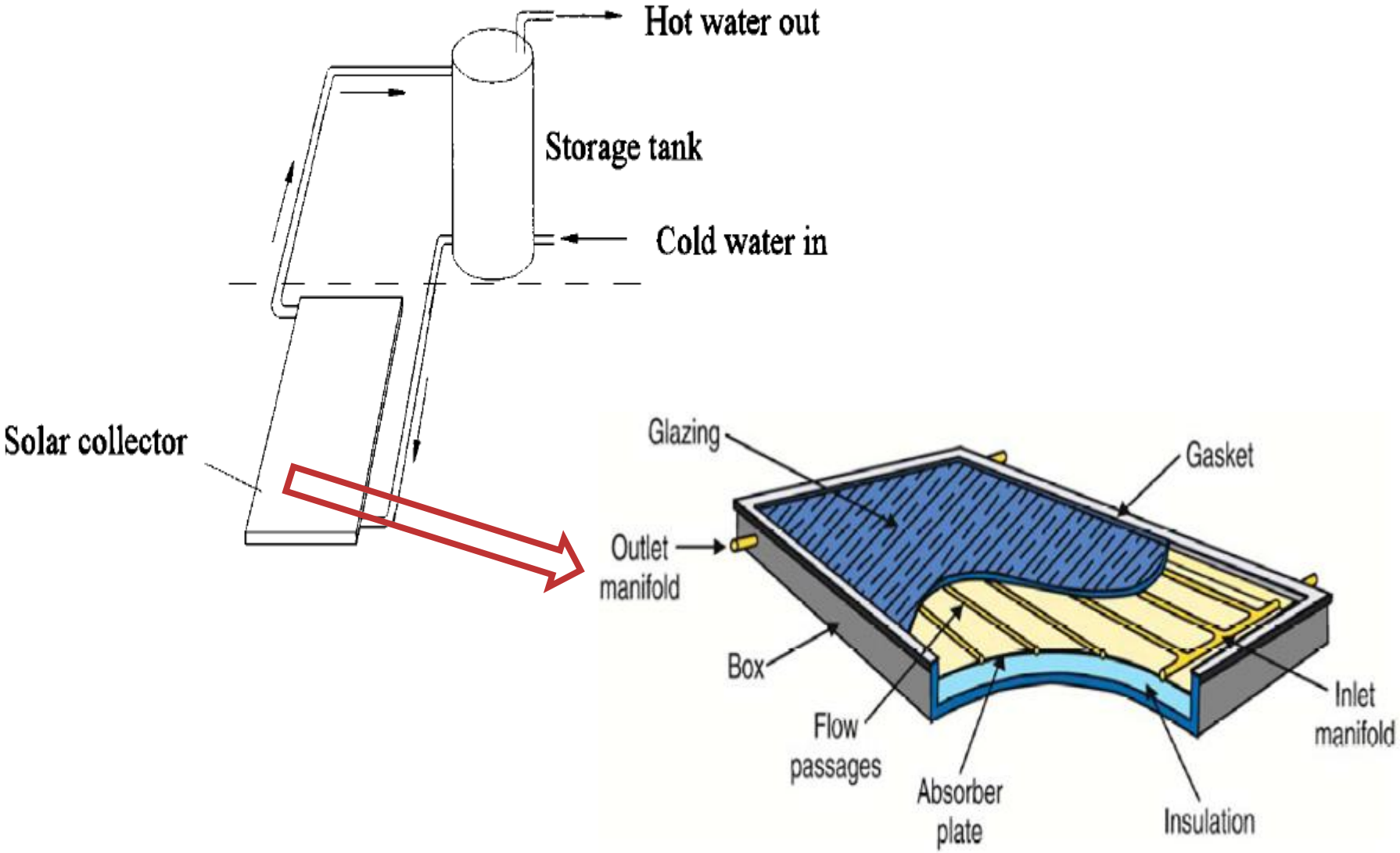
Source: NASA

Challenge: harnessing solar power more effectively and efficiently, to reduce dependence on traditional/fossil fuels

Solar thermal technology is used for harnessing solar energy for heat applications



Solar thermal collectors for water heating use a spectrally selective surface that absorb sunlight and convert it to heat



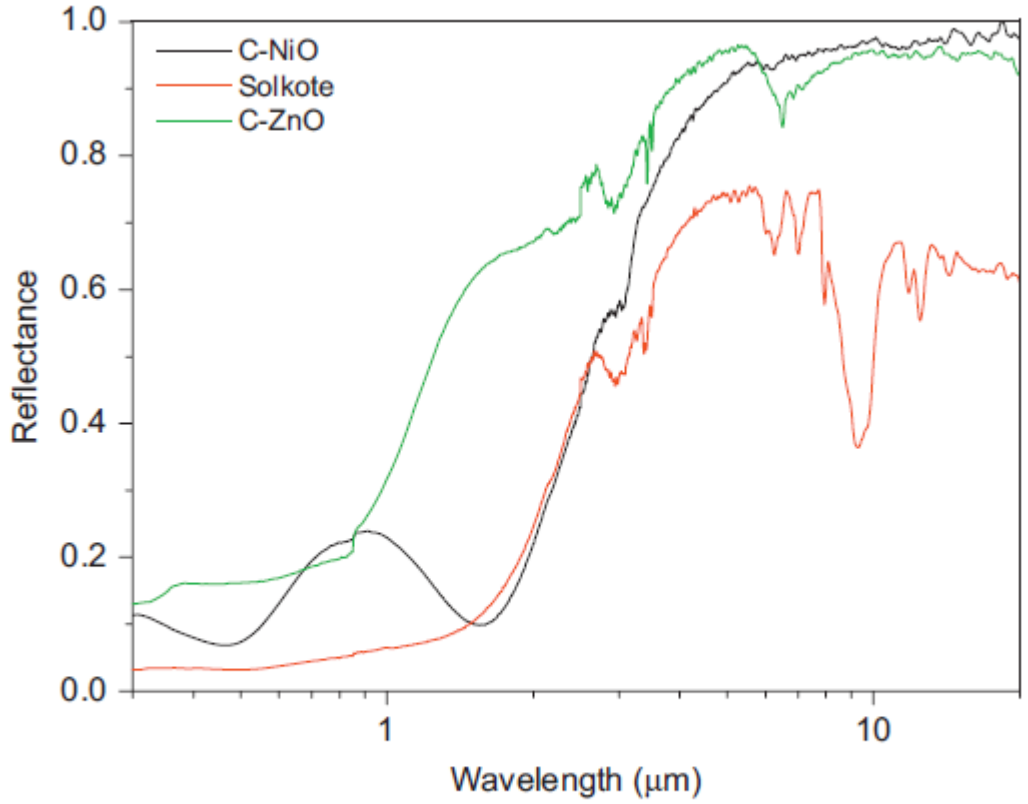


Fig. 13. The solar selectivity curves of C–ZnO and C–NiO based samples. The curve for a commercial Solkote paint is included for comparison.

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C-NiO has been found to have good spectrally selective properties

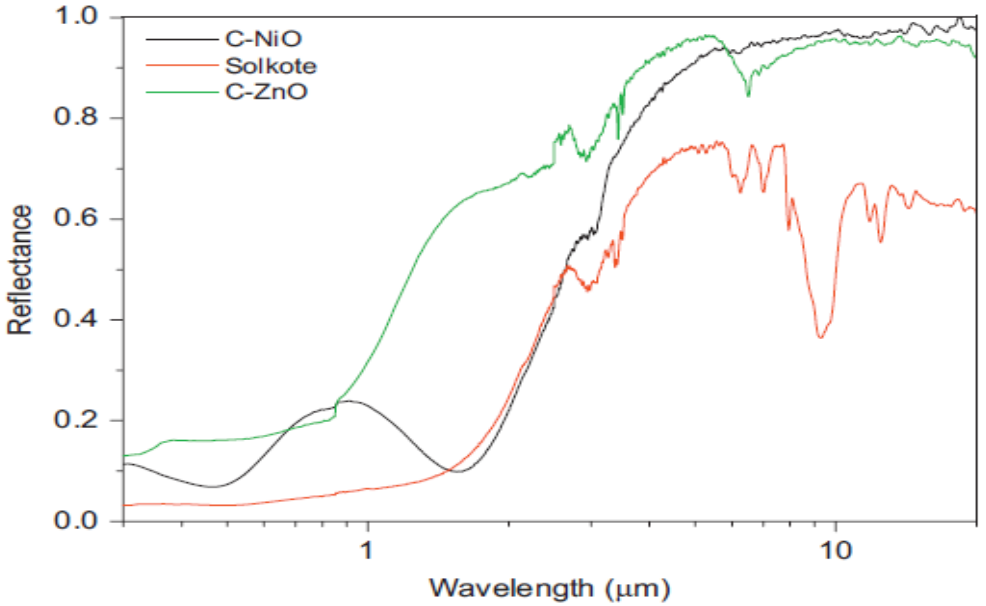

Fig. 13. The solar selectivity curves of C–ZnO and C–NiO based samples. The curve for a commercial Solkote paint is included for comparison.

Table 1
The solar selectivity of the C–ZnO, C–NiO and Solkote paint coatings on aluminium substrates

Sample	α	ε	α/ε
Solkote	0.93	0.33	2.85
C–ZnO	0.71	0.06	12.70
C–NiO	0.84	0.04	20.91

A figure of merit is given in column 4 for easier comparison.

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Preliminary studies showed that C-NiO is durable

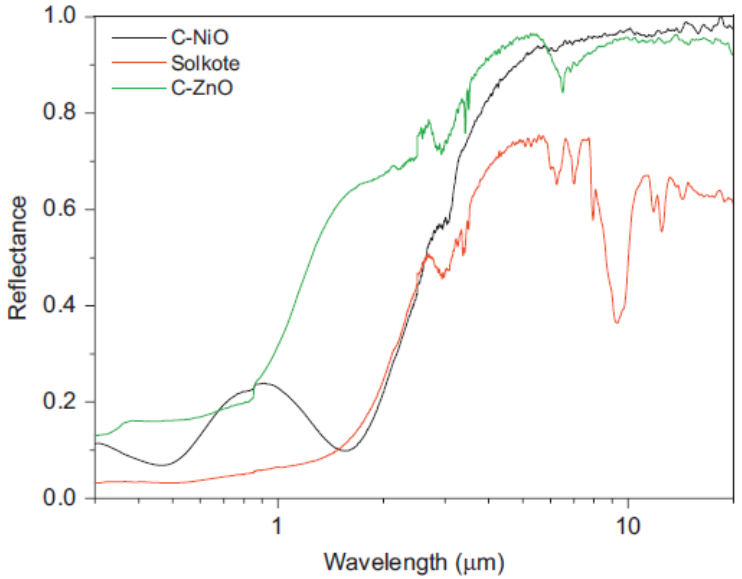

Fig. 13. The solar selectivity curves of C–ZnO and C–NiO based samples. The curve for a commercial Solkote paint is included for comparison.

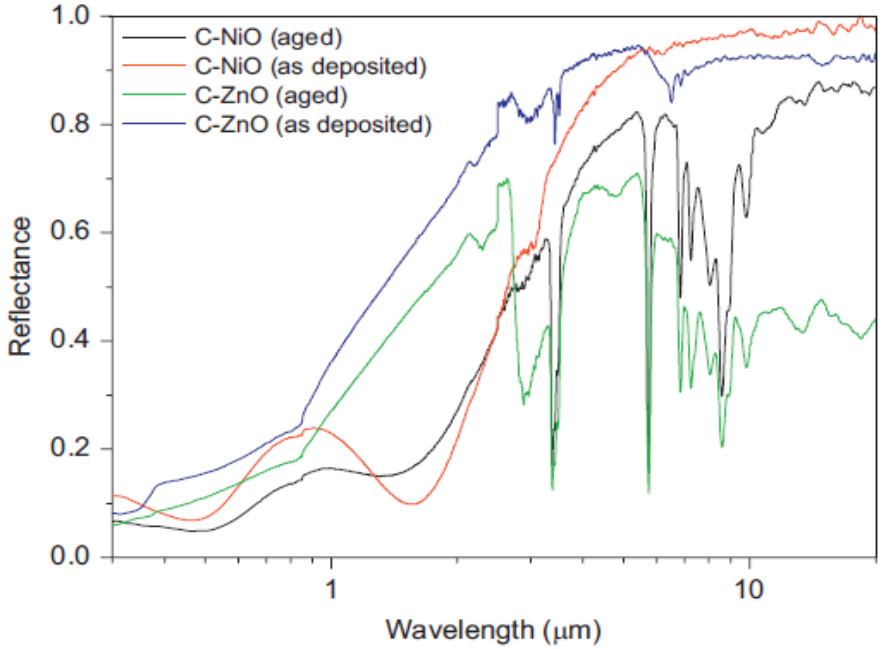

Fig. 15. Normal reflectance curves for the as-deposited C–ZnO and C–NiO samples and corresponding curves of the same samples after ageing.

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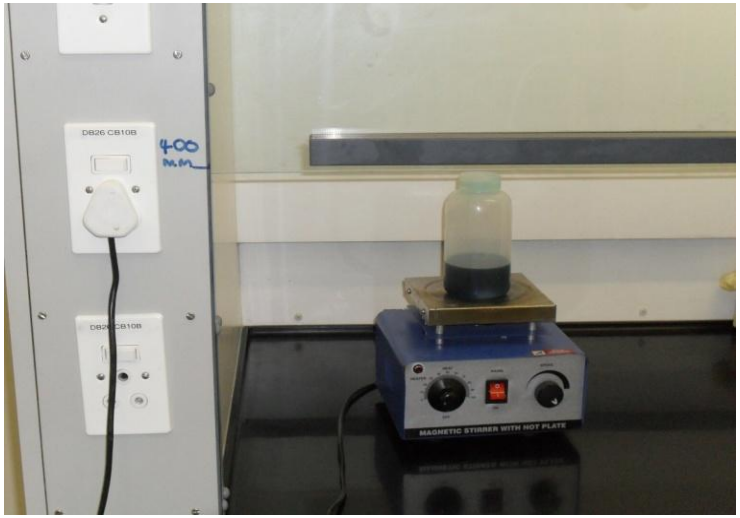
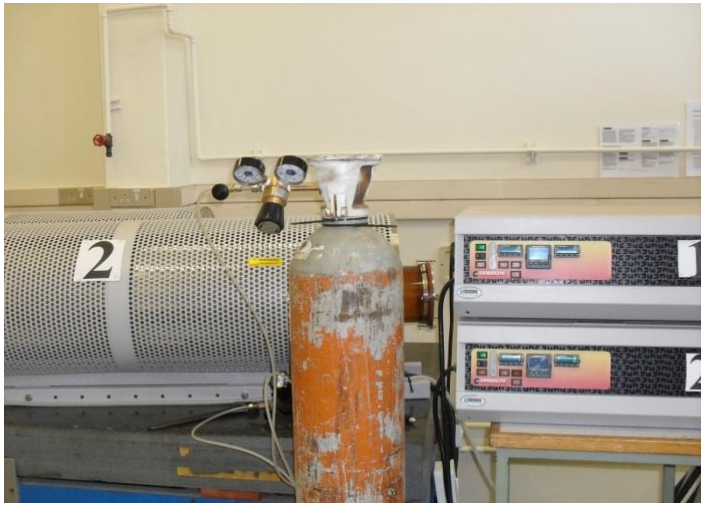
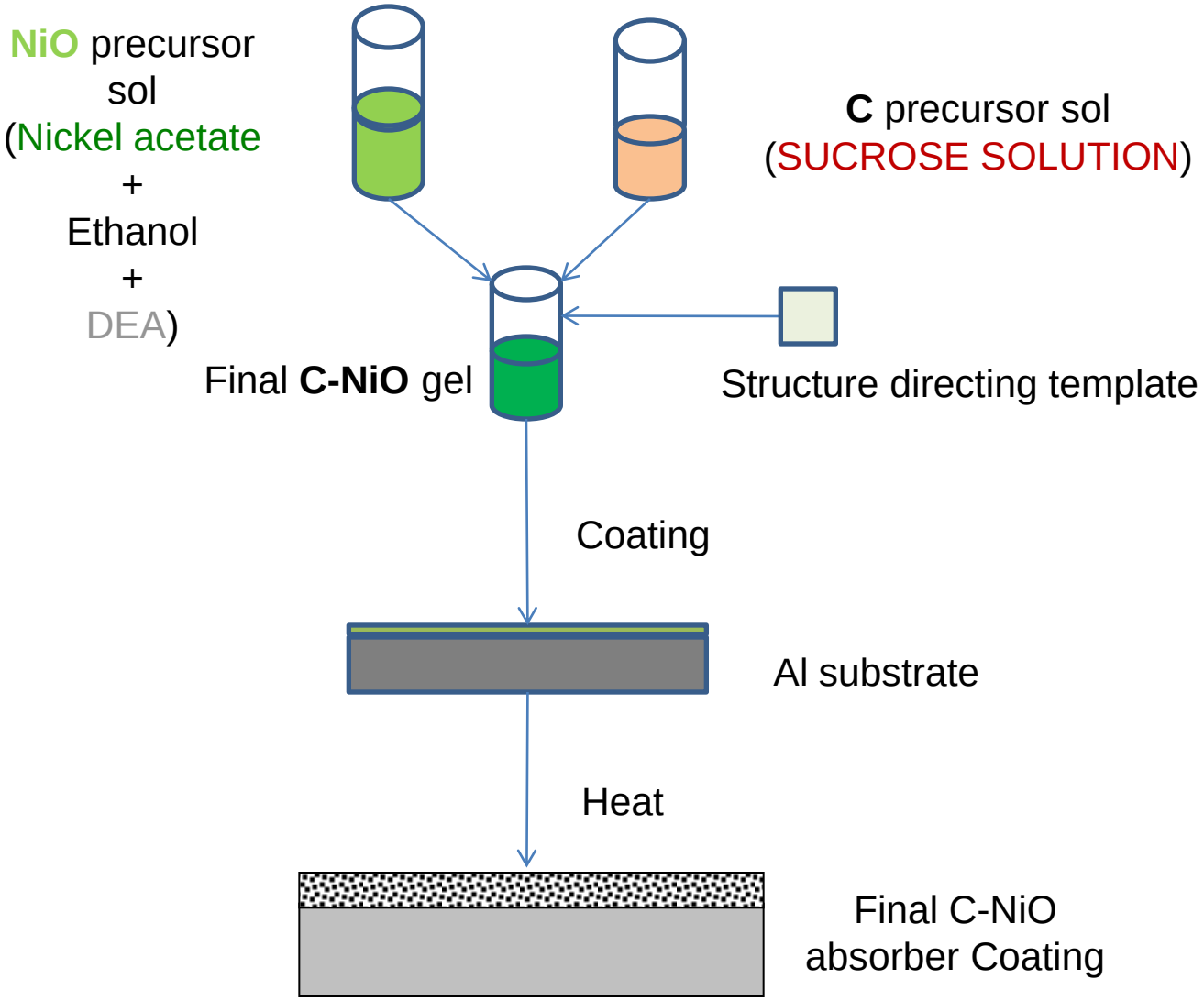
The samples are fabricated in a simple wet chemistry lab following a simple 3 step procedure



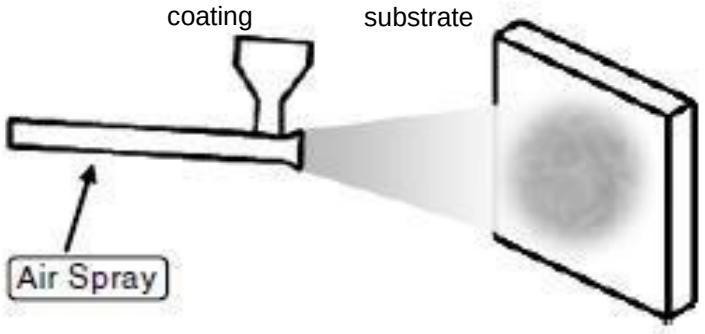


By suitable choice of precursor, we can engineer novel composite materials



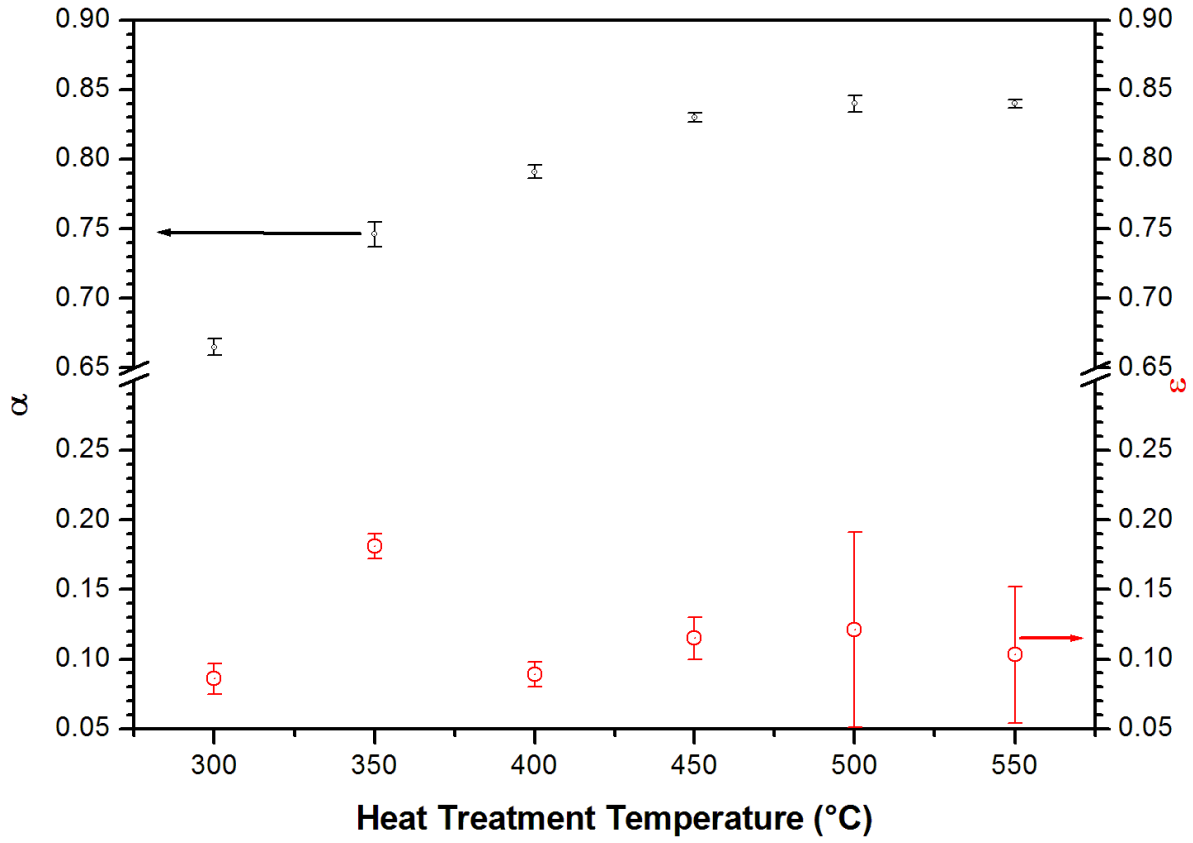
Sol-gel technique can be adapted to different coating methods

Spin coating

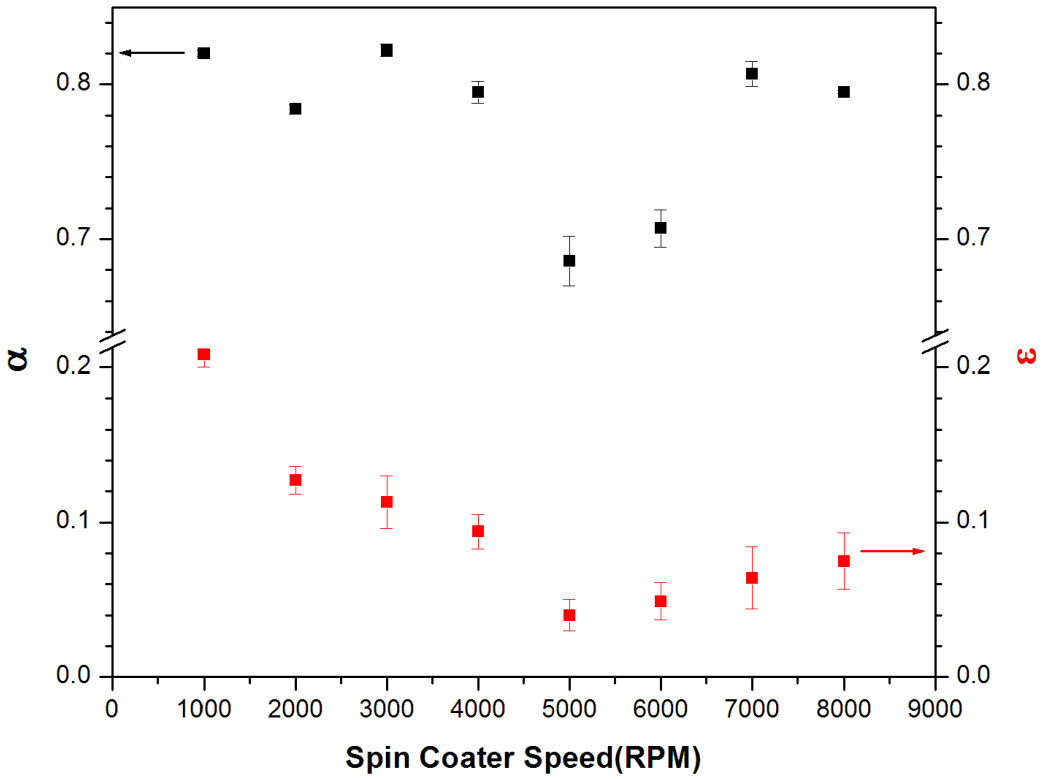


Spray coating

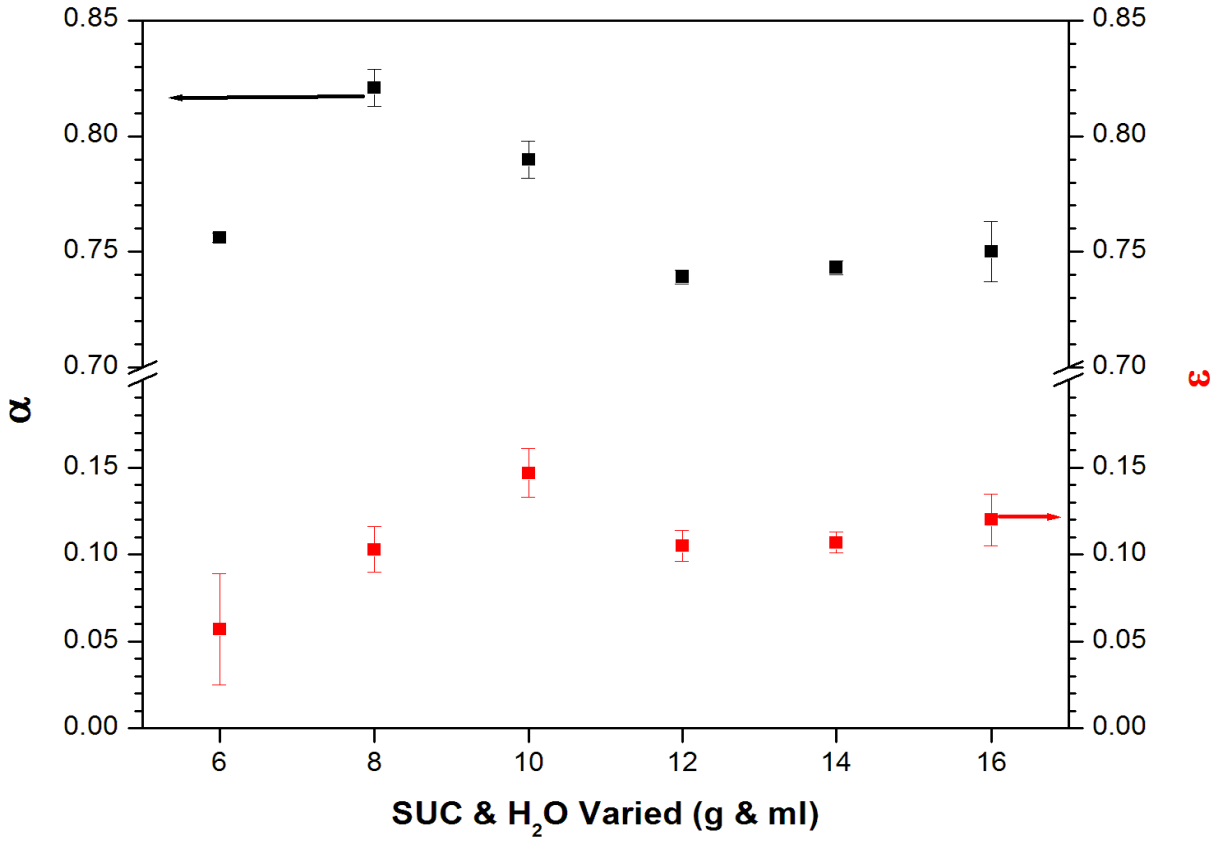
Absorption properties improve with an increase in heat treatment temperature



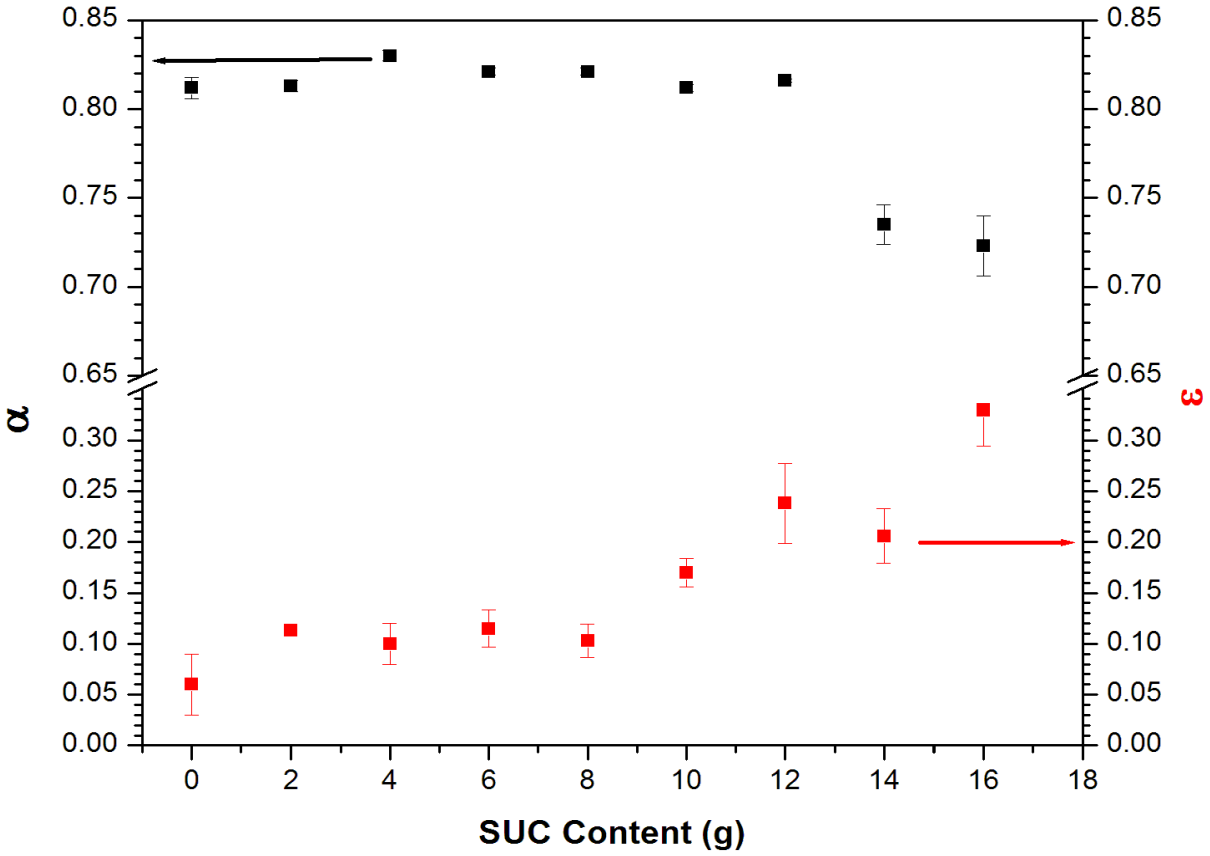
Emittance decreases with an increase in coating speed



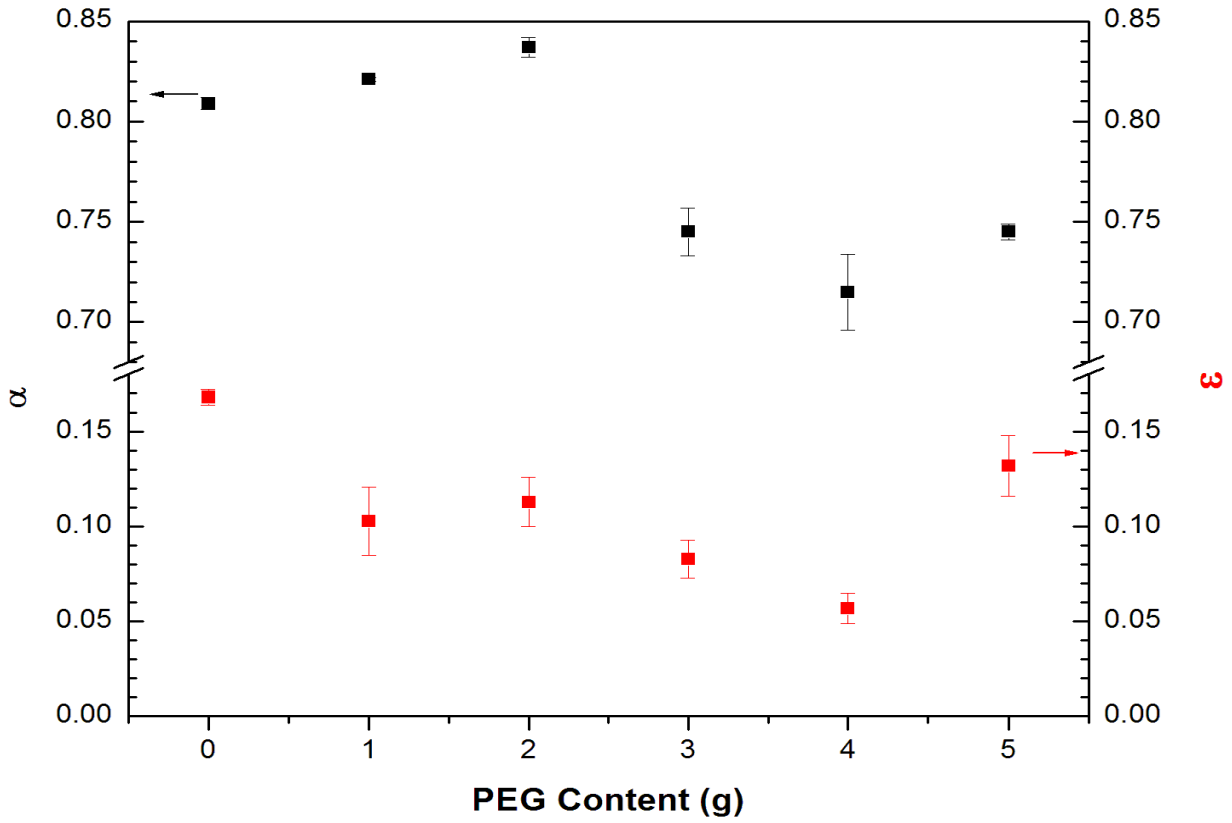
Absorption properties deteriorate with an increase in SUC and water content

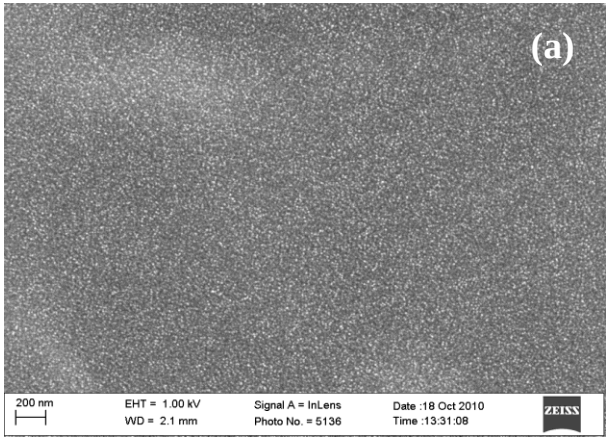


Absorption properties are constant from 0-8 grams SUC



Absorption properties vary with PEG content peaking at 2 grams




(a)
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WD = 2.1 mm
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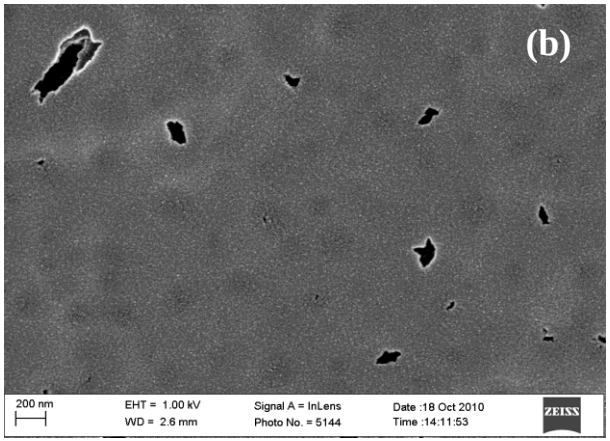
ZEISS


(b)
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WD = 2.6 mm
Signal A = InLens
Photo No. = 5144
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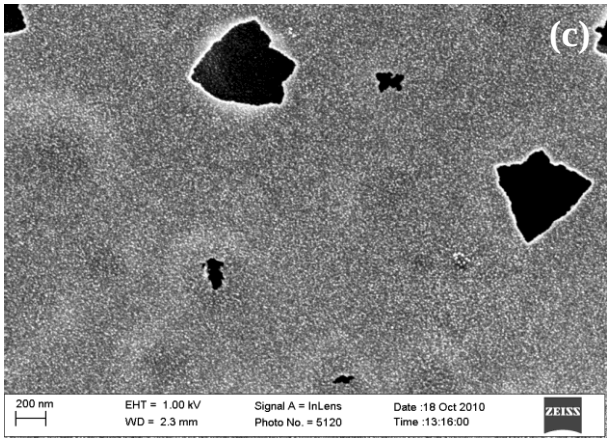
(c)
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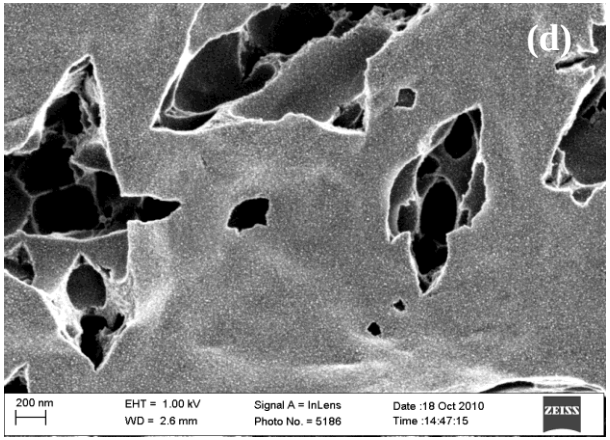
(d)
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WD = 2.6 mm
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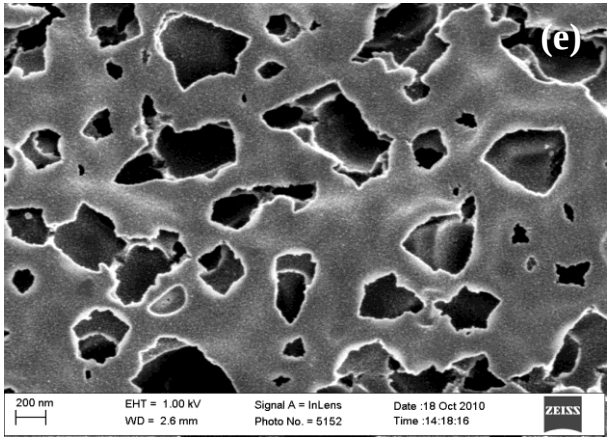
(e)
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WD = 2.6 mm
Signal A = InLens
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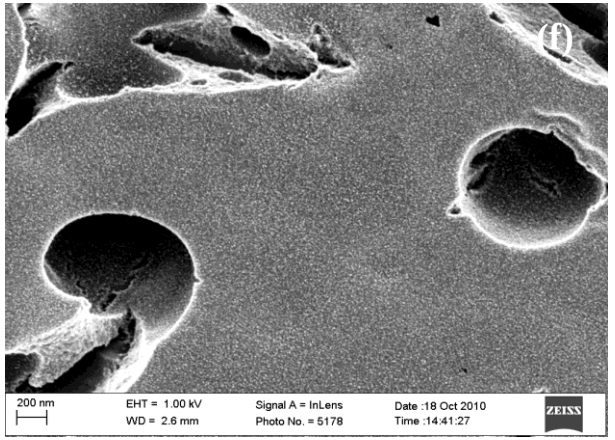
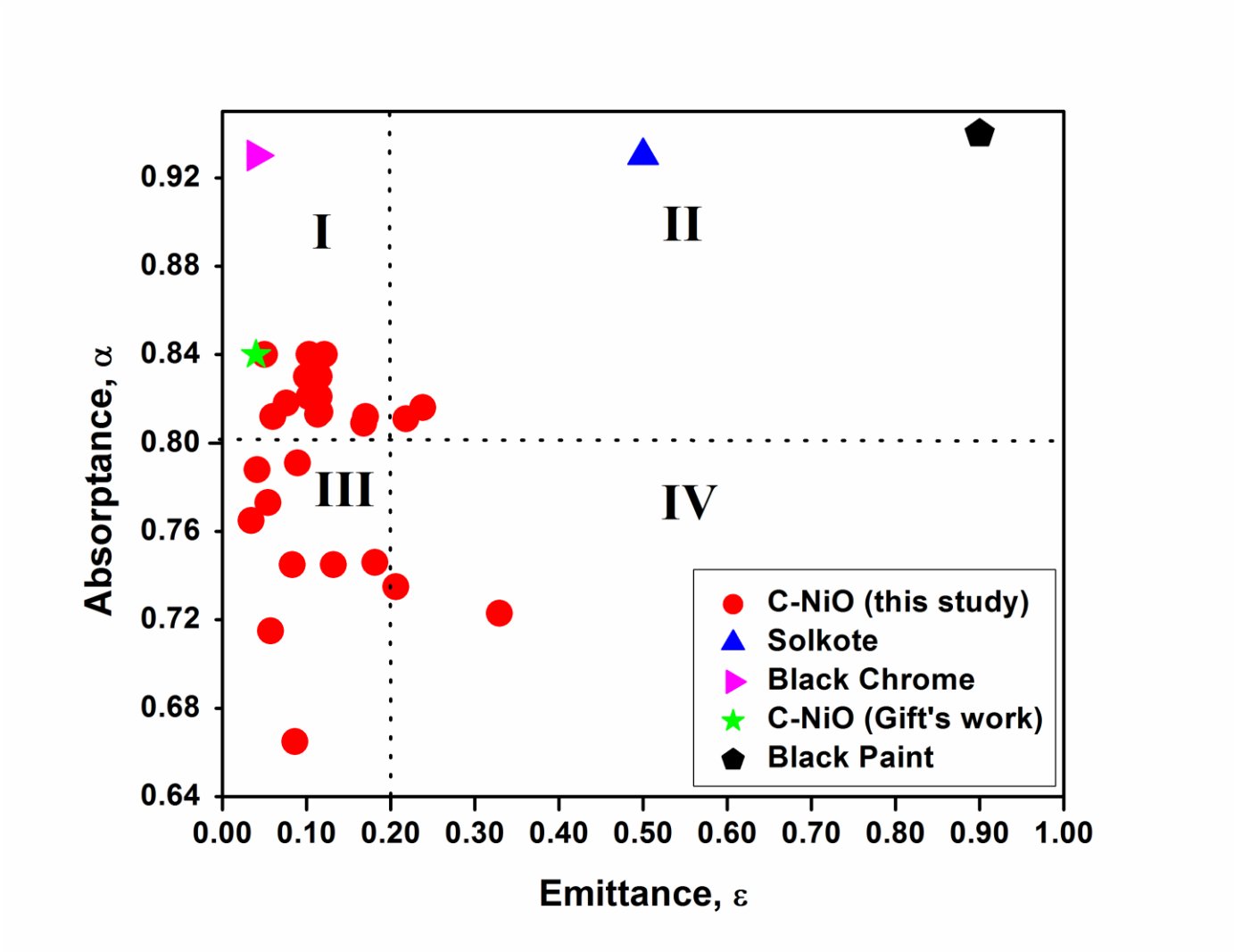

(f)
200 nm
EHT = 1.00 kV
WD = 2.6 mm
Signal A = InLens
Photo No. = 5178
Date :18 Oct 2010
Time :14:41:27
ZEISS

Summary of best parameters

Parameter	Optimum
Anneal temperature	450-550°C
Coating speed	3000 RPM
Sucrose content	0-10 grams (Water fixed)
PEG content	2 grams
No. Of passes	1

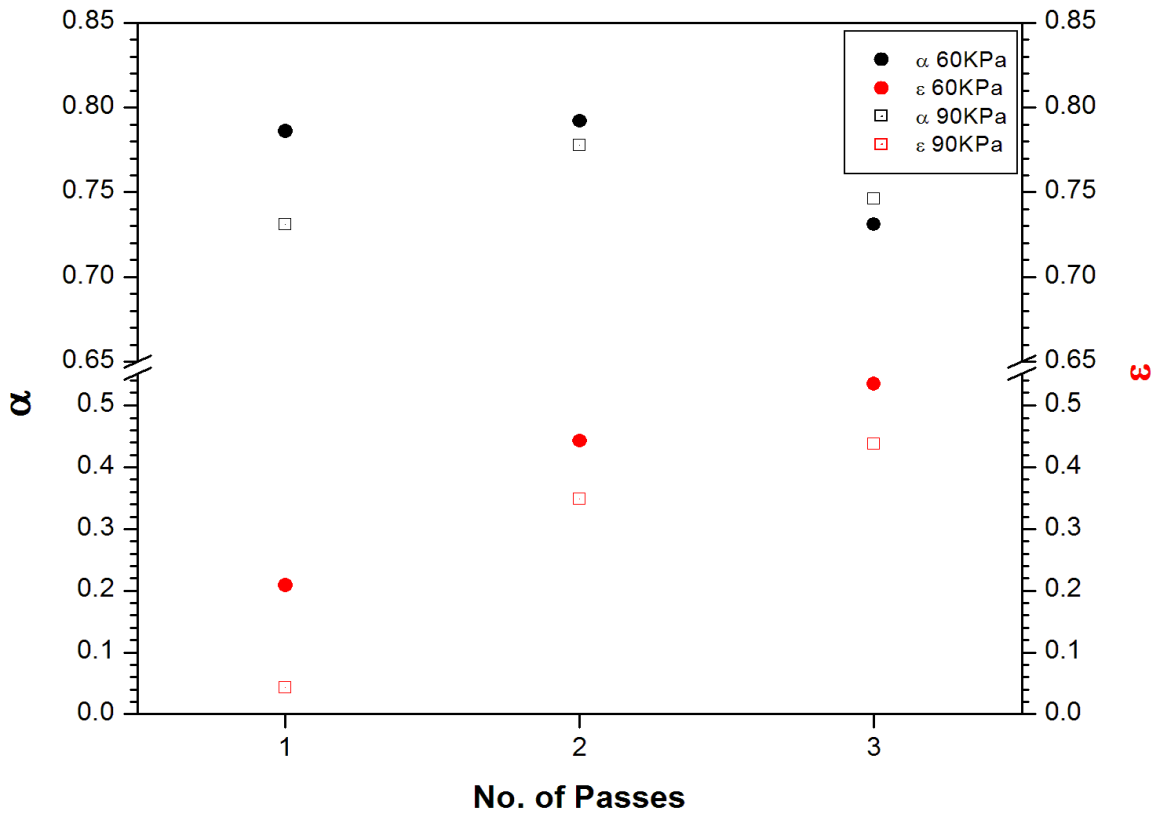
Summary of the most important results



The cost of our coating is relatively cheap

COATING	COST/M^2 LAB SCALE	COST/M^2 BULK SCALE
C-NiO	R 14.50	R 0.65
Solkote	-	R 12
Black Paint	-	R 4
Black Chrome	-	R 20
Nickel-Alumina	-	R 1.50

Absorption properties worsen as number of passes increases



Ongoing…….

Thank You

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