Anti-Reflection Coatings for Low E Glazing

Summary

Whilst Low E coatings enhance the energy efficiency of window glazing, they do not *maximise* the energy gain - due to increased reflection losses. Low E coatings can increase the reflection from the coated surface by more than 200%, compared to the base glass. When employed in multiple glazing/multiple Low E coating configurations (including anti-condensation external layers), this issue is therefore multiplied. Furthermore, multiple coatings also lead to degradation of the view through image due to increased multiple reflections. A possible solution to these issues may be found by applying anti-reflection (AR) coatings and particularly onto the Low E coated surfaces (as these have higher reflection levels).

Such coatings would need not only to exhibit sufficient anti-reflection performance, but would have to not deteriorate the Low E performance significantly, and avoid introducing unacceptable levels of haze. Ideally the layer would also have low angular sensitivity. Furthermore, the chosen deposition technology would need to meet challenging cost targets and be capable of scaling to large areas and high throughput volumes.

Approach

In this work we have explored Flame Assisted CVD (FACVD) to achieve AR functionality. The flame delivers activation energy to the precursor and reduces the substrate temperature needed to achieve fast growth and durability (to as low as 100C).

Experimental

The FACVD configuration is illustrated in fig 3. The system has been described previously (ref. 1). The precursor (organosilanes) can be delivered as an aerosol or be pre-vapourised (via flash evaporation) depending on precursor employed. This is then mixed with a flammable gas prior to being ignited. The flame energy activates the chemical reactions leading to deposition. The flame is located in contact with the substrate , and either the flame head or the substrate are moved to allow area coating.

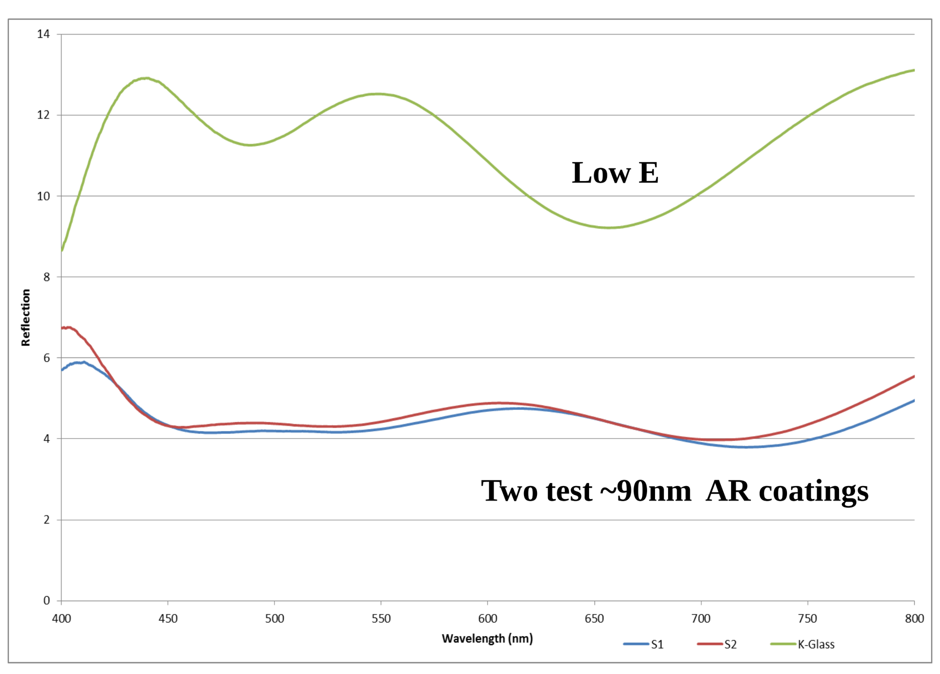

Fig 1a Reflection before and after AR coating Low E

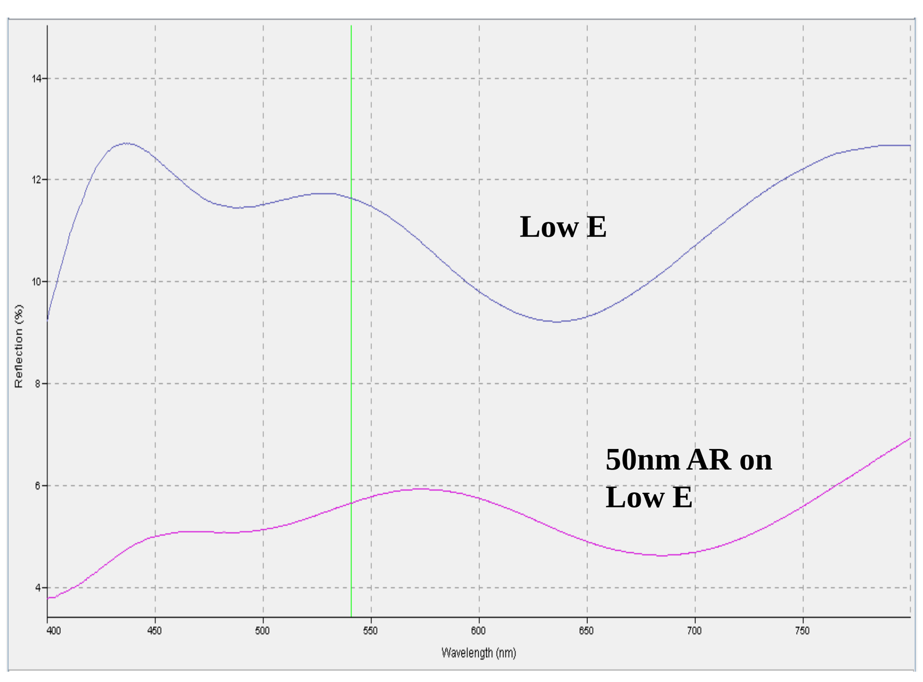

Fig 1b Reflection 50nm AR on Low E

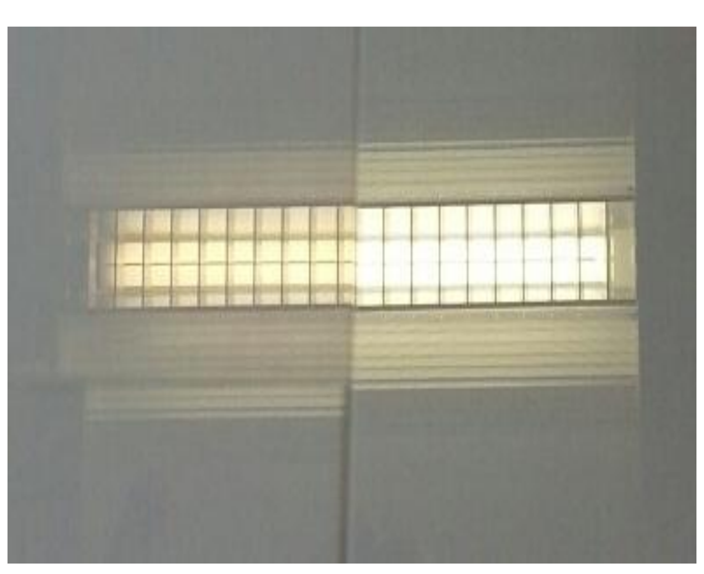

Fig 2 Reflection from light fitting–left side AR coated

Results

Very high AR performance has been achieved, even in a single layer coating (see fig 1 and table 1). This is achieved by producing a graded Refractive Index structure. The resulting AR performance can reduce the normal Low E surface reflection by up to 90% and furthermore have a wide bandwidth across the visible - reducing colour and angular sensitivity.

Table 1 illustrates typical AR film on Low E properties and includes comparison with a reference commercial Low E film (also with same AR coating on top). AR performance and properties can be adjusted and balanced. For example, Fig 1a demonstrates a very high AR suppression level but a thinner film (fig. 1b) still achieves much of this gain. Colour (reflected) could be adjusted by varying the Low E coating structure to accommodate the extra AR optical thickness (not done in this work due to employing Commercial Low E) as substrate. The AR coatings are toughenable.

Process Technology

FACVD operates in open air and in this application uses low toxicity and low cost precursors. FACVD capital costs are also *relatively* low and the technology is scalable from small to very large substrates, and up to high throughput capable system (see fig 5). Example configurations would be installation above an in-line conveyor or onto a Float Glass production line. FACVD also offers *relatively* easy integration into customer production lines, and is compatible with in-line operation at atmospheric pressure. Target coating costs are significantly below $ 0.5 m-2

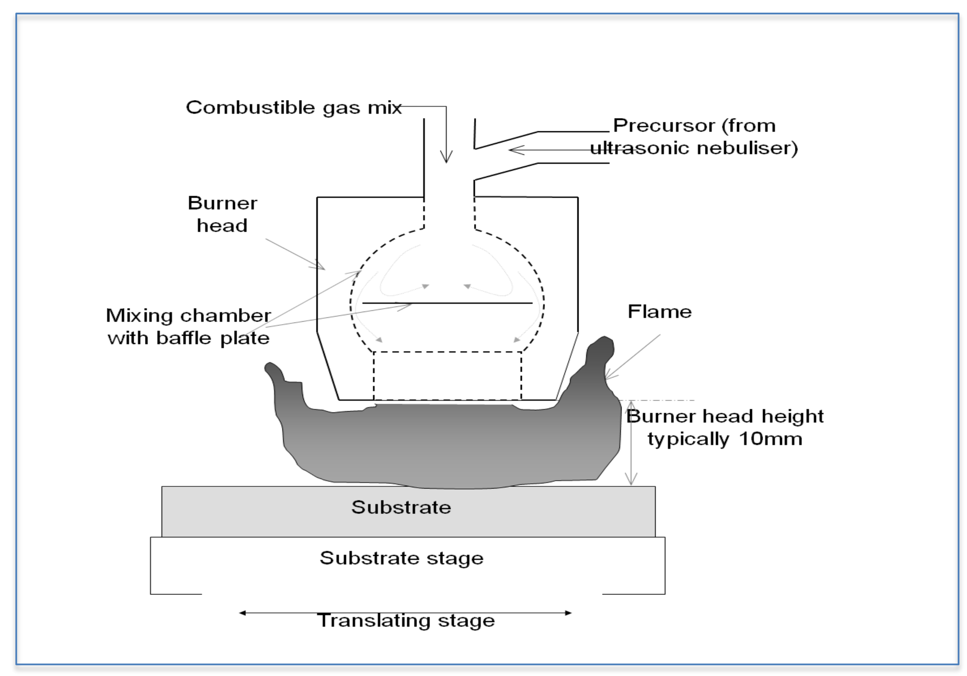

Fig 3 Schematic of FACVD operation

Fig 4 Laboratory In-Line coating by FACVD

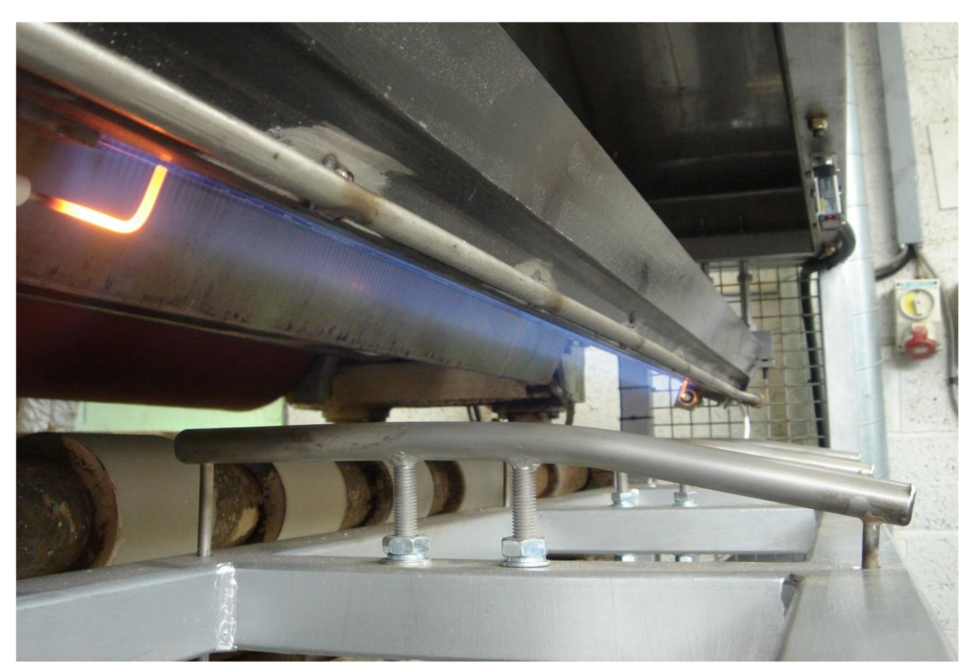

Fig 5 Large Scale Flame Surface Treatment Technology

Table 1: results comparison

	Thickn. (of AR) nm	Refl. (front surface only) % ----	Tran. -@500nm	Haze %	Colour L a*b*
Low E (commercial - CVD)	0	8	82	0.4	40, -2, -0.5
Thick AR	90	0.5	88	0.7	25, 1.7, 3.3
Thin AR	50	1.5	87	0.5	33, -1.5, 0.5

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References

1. J. Nanosci. Nanotechnol. 2011, Vol. 11. no 9

Way Forward

The company is now seeking collaborator(s) to pilot the technology. A patent has been filed.

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