Chemical Vapor Deposition of Coatings On Glass

Online Lecture February 26, 2015

Post-lecture Homework

A. Coating Design

You are selling a passive low-E coated glass product that has an emissivity of $\varepsilon = 0.18$ and a heat transfer coefficient due to thermal radiation of $h_{rad} = 1.08$ W/m^2/K. The thickness of this coating is 300nm.

A new customer has an application requiring $h_{rad} = 0.91$ W/m^2/K.

The market requires an a*b* color in the third quadrant (i.e., both a* and b* have negative values) and values a neutral color (a*b* Cartesian distance from (0,0) is less than 4) as compared to one that is less neutral.

1. What is the minimum coating thickness required to achieve this performance?
2. What reflective color would be expected with this coating? Would this color be acceptable to the market?
3. From the thicknesses listed in the table, what coating thickness would you recommend to meet the thermal performance and acceptable color specifications?
4. Would you expect improved market acceptance for the new product vs. the existing product – why?

B. Process Design

For each of the slots in the coater, 36.5 lb/hr of MBTC with 20 SCFM vaporizer N_2 and 75 SCFM total flow is used to achieve the desired coating thickness on 6.0 mm thick substrate.

Because of the negative effect on cross section ribbon uniformity, the total flow must be in the range 40-90 SCFM.

5. What is the flow rate of MBTC is needed to achieve the same coating thickness on 4.0 mm thick glass?
6. If the vaporizer temperature for the 6.0 mm process is 275F, what is the minimum temperature for operation under the new conditions?
7. If the maximum operating temperature for the vaporizer is 280F, what is the maximum MBTC precursor flow rate that can be run? With this limitation, what other changes to the process (without equipment modifications) can be made to achieve the desired coating thickness on 4.0 mm thick glass?

Color L*a*b* coordinates vs Coating Thickness (nm)

Coating Thickness (nm)	a*	b*
300	-2.98	-6.29
320	-11.68	1.21
340	-10.57	4.27
360	-2.39	1.02
380	5.48	-3.69
400	7.76	-5.45
420	3.75	-3.58
440	-2.67	-0.74
460	-6.20	-0.15
480	-5.07	-1.78
500	-1.65	-3.20