

# Multilayer Slide Coating: Flow Imaging

R. P. Alpin and H. Benkreira\*

School of Engineering,

RKT Centre in Advanced Materials Engineering

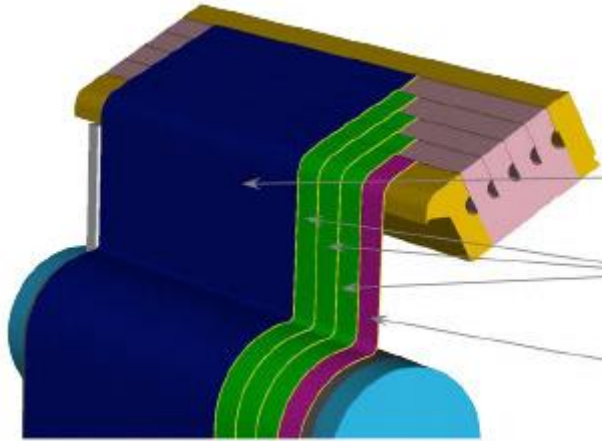
University of Bradford, UK

\*Email: [H.Benkreira@bradford.ac.uk](mailto:H.Benkreira@bradford.ac.uk)

## Abstract

In the high technology industries such as in the manufacture of photovoltaic cells, batteries and drug release patches, a requirement for roll to roll production is the ability to coat multilayer films in one pass (see Figure 1), at high speeds and without any defects such as those resulting from surface and interlayer instabilities. This paper describes research to establish the coating window for such applications. It reports the results of imaging the flow out of a 3-layer slide die when the flow rates and the viscosities of the individual layers and the incline angle of the die are manipulated. The slide die was made from stainless steel to the highest industrial specifications and fitted with sapphire glass windows on each side along the whole path of the slide as shown in Figure 2. A Microtron EoSens MC1362 high speed camera was used under cold illumination to capture a reduced image of 1056 x 406 pixels giving a frame rate up to 1283s<sup>-1</sup> and shutter speed of 773μs. This was used together with an Edmund Optics 0.5XTML 63074 telecentric lens giving an image resolution of 36pixels/mm. This enabled the capture of the flow streams as they emerged from the slot and combined to produce the final film. Figure 3 gives typical views obtained.

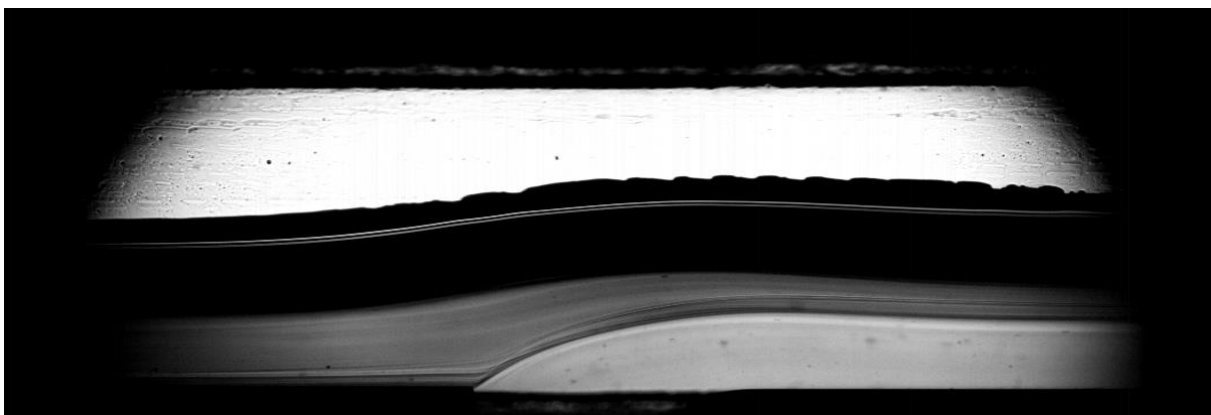
In the presentation we shall describe the experimental apparatus and method, the results of our observations and propose a coating window that demarcate stable operation. In particular, we will present images of the start-up flow as it emerges immediately out the slot and how, depending on flow rates, viscosities and incline angle, these flows combine and develop to form stable or unstable films, for a single layer first then for two and three layers. Figure 3 gives typical views obtained. As the images capture precisely the thickness of the film layers, we will also compare these thicknesses with model predictions.



**Figure 1 - A multilayer slide die curtain coater delivering a five layer film onto a substrate  
TSE Troller AG (2015).**



**Figure 2 – Images of the experimental equipment. On the left is the full experimental setup showing the camera and lens in relation to the die. On the right is a view through the sapphire glass onto the slide with the slot exits being visible.**



**Figure 3 – Two layer flow down the incline at a die angle of 23°.**

#### References

TSE Troller AG (2015) *Curtain Coating in Industry*. [Online] Available from: <http://www.copybook.com/packaging/tse-troller-ag/articles/paper-curtain-coating> [Accessed: 16.04.2015]