PARTICLE TRACKING AS A TOOL FOR LOCAL, REAL-TIME ANALYSIS OF SAG IN DRYING COATINGS[1]

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Sagging is a coating defect characterized by excessive, gravity-driven flow after deposition.[2] In this work, a new method for quantifying and evaluating sag is investigated. By tracking the motion of micron-sized *Lycopodium* spores on a coating surface, the extent of sagging can not only be monitored in real-time throughout the entire drying process, but at local, microscopic length scales (see Fig. 1).[3] This particle tracking method allows a coating's sag resistance to be evaluated in situations that parallel the coating's end-use application, an aspect that most conventional sag evaluation techniques do not possess. Results measuring the real-time sag velocities and lengths for aqueous polyvinyl alcohol coatings are compared against a theoretical model; agreement between this model and experimental data are used to validate this method of sag measurement.

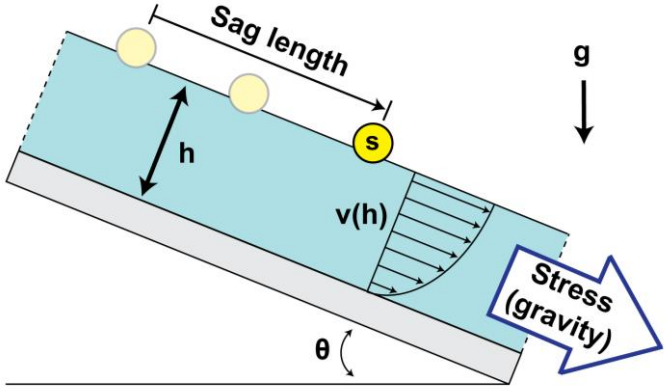

Figure 1. Schematic of sag and particle tracking, showing velocity profile, v(h), in film and gravity-driven stress which perpetuates sag. Sag length is the total distance the coating surface flows after deposition before drying. s: *Lycopodium* spore; g: gravity; h: film thickness; θ: angle of inclination.

Using the model, a predictive sag regime map was developed to predict a coating's sag behavior based on coating thickness, solution properties including viscosity and density, and substrate angle. This map enables a fundamentals-based, practical approach to predicting and evaluating a coating's resistance to sag and can also be used to intelligently design and/or modify a coating to minimize sag. Comparisons between the map prediction, experimental results, and results in the literature are presented, including comparison with polyvinyl alcohol coatings and several commercial paints.

Our novel spore technique is also compared with an established technique for determining sag resistance: sag meters. These multinotched blade coaters apply a series of parallel lines of increasing thickness to a substrate and can be used to evaluate sag resistance. Though valued for the simplicity and reproducible nature of their tests, sag meters only provide indirect information on sag resistance. The nature of this test is contrasted with our own sag resistance evaluation method, which provides a direct, *in situ* measurement of sag. Our results show that the spore tracking method is also more sensitive and versatile than the sag meter and other existing methods, including better compatibility with low viscosity and translucent coatings.

References:

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