Regime Maps to Predict Sag in Drying Coatings and a New Method to Measure Sag

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Coating appearance depends on a multitude of process and coating parameters, and how these parameters are controlled during processing can decide whether or not defects are present [1]. One such defect, sag, is the result of excessive gravity-driven coating flow after deposition. The detrimental impact of sag illustrates the importance of monitoring and measuring flow after coating deposition.

In this work [2,3], we introduce and validate a novel method for measuring sag in real time in drying coatings. Polyvinyl alcohol (PVA) solution coatings are positioned on an inclined, heated stage and, under the influence of gravity, the coating flows (sags) as it dries. Using optical microscopy, the movement of micron-scale *Lycopodium* spores is used to monitor this sag in real time (Fig. 1a). A simple model is developed in conjunction with these experiments; it is shown that the model and experimental results are in good agreement.

Using the above-mentioned model, a predictive sag regime map is also developed (Fig. 1b). The map predicts the extent to which a coating will sag based on its 'sag number' (see Fig. 1 caption). The predictions of this map are compared with sag measurements taken with PVA solution coatings and latex paints, revealing good agreement for coatings with Newtonian or nearly-Newtonian rheologies.

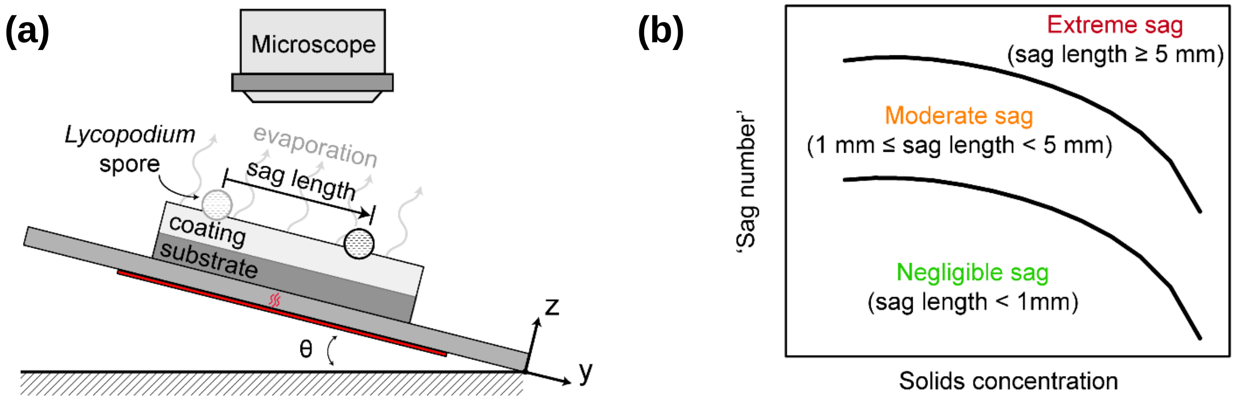

Fig. 1. (a) Schematic of particle tracking set up (b) Sag regime map. The sag number is a dimensionless ratio of an evaporation time scale to a flow (sag) time scale, and depends on the initial properties of the coating, such as initial viscosity and thickness. Adapted from Ref. [2].

This work provides a new technique with which sag can be measured both locally and in real time, which sets it apart from existing methods. The sag regime map provides a unique perspective for predicting and mitigating sag, as well as an opportunity for the intelligent design of sag-resistant coating processes. Future work will deal with modifying the regime map to accommodate more complex coating behaviors, such as thixotropy. The authors would like to thank the industrial partners of the Coating Process Fundamentals Program (CPFP) of the Industrial Partnership for Research in Interfacial and Materials Engineering (IPRIME) for supporting this research.

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