Interdiffusion of two polymer layers during drying

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For solution-processed multilayer coatings the interdiffusion of the single layers is of great importance for the product quality. For example, in the case of organic light-emitting diodes (OLEDs), the required device architecture consists of several functional nano-layers. State-of the-art processing is step-by-step coating of a wet film including drying, before the following functional layer is applied on top as wet film. During this process, the solvent of the top wet film could dissolve the dry bottom layer and thus cause a solid interdiffusion, which would affect the OLED functionality. While layer interdiffusion must be prevented for the fabrication of OLEDs, a controlled interdiffusion is required for other multilayer applications. Therefore, a fundamental understanding of the interdiffusion behavior in solution-processed multilayers has to be developed.

Up to now, there exist only a few investigations on the interdiffusion of two solids in presence of a solvent. In this study, a general model for the description of diffusion in polymer double layers was developed in order to predict the interdiffusion of the three components. The validation of the model is based on experimental investigations of different polymer-polymer-solvent systems using Inverse Micro Raman Spectroscopy (IMRS). With this measurement method, the local distribution of each component of the double layer system can be determined at different times (see Figure 1). The thickness of the investigated double layers is in the micrometer range. The influence of various parameters such as solvent content or polymer chain length on the interdiffusion behavior is of particular interest [1].

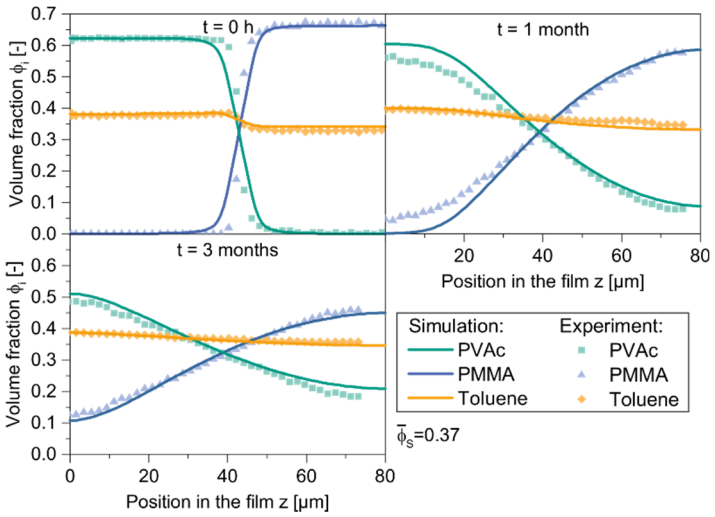

Figure 1: Comparison of simulation (solid lines) and experiment (symbols). Concentration profiles are displayed for PMMA-PVAc-toluene at 20 °C and an average toluene content of 37 vol% [2].

In the future, not only covered double layers (without solvent evaporation), but also drying systems will be considered. As a result, a large number of new challenges arises, such as the description of film shrinkage or skin formation.

References

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