

Surfactant Spreading on Drying Latex Films

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Understanding surfactant spreading on drying latex films can potentially help create controlled surface patterns on painted surfaces. Here we investigate the spreading of a soluble surfactant on a latex dispersion drying on a horizontal substrate. The surfactant concentration gradients at the film surface can induce convective flow (Marangoni flow) in the fluid beneath the surface. In this project we use both experimental and modeling techniques to investigate the relative importance of surfactant diffusion, evaporative and Marangoni convections in determining the type of surface patterns obtained at the end of drying. In the experimental part, profilometry is used to compare the surface profiles of dried latex films over which surfactants were allowed to spread over varying lengths of time. This helps investigate the dependence of extent of spreading and the spreading pattern on the relative magnitudes of evaporative, diffusive and Marangoni time scales. In the modeling approach, we model the surfactant spreading by coupling the film height evolution equation with the conservation equations for particles and surfactant in the Lubrication limit. The solution of the coupled equations gives the film height profile and the size of the surfactant spreading during the film drying process. Parametric analysis reveals the relative importance of surface diffusion, evaporative and Marangoni convections on the spreading process.