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A minimal model of solvent evaporation and absorption in thin films GIULIA L. FERRETTI, MATTHEW G. HENNESSY, JOAO T. CABRAL, OMAR K. MATAR, Imperial College London — We present a minimal model of solvent evaporation and absorption in thin multicomponent films that consist of a volatile solvent and one or many non-volatile solutes. A detailed asymptotic analysis is carried out in order to (i) elucidate the key regimes that occur during evaporation and absorption and (ii) compute solutions that facilitate the extraction of physically significant model parameters from experimental data. A state diagram of the drying process is constructed and used to predict the experimental conditions that lead to the formation of a solute-rich skin below the evaporating surface. In the case of solvent absorption, the model predicts the existence of a diffuse saturation front that propagates from the film surface towards the substrate. The theoretical results are found to be in excellent agreement with data produced from dynamic vapour sorption experiments of ternary mixtures composed of an aluminum salt, glycerol, and water. Finally, we show how the model can be used to predict the drying and absorption dynamics over a wide range of experimental conditions.

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