

Stratification of polymer–colloid mixtures via fast nonequilibrium evaporation

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In drying films of polymer–colloid mixtures, the stratification where polymers are placed on top of larger colloids is studied. It is often presumed that the formation of segregated polymer–colloid layers is solely due to the proportion in size at fast evaporation. By comparing experiments with a theoretical model, we found that the transition in viscosity near the drying interface was another important parameter for stratification in polymer–colloid mixtures. At high evaporation rates, increased polymer concentrations near the surface lead to a phase transition from semidilute to concentrated regime, where colloidal particles are kinetically arrested. Stratification only occurs if the formation of a stratified layer precedes the evolution to the concentrated regime near the drying interfaces. Otherwise, the colloids will be trapped by the polymers in the concentrated regime before forming a segregated layer. Our findings are relevant for developing solution–cast polymer composite for painting, antifouling and antireflective coatings.