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Author: Dr. Juan Sabin
Simon Fraser University, Canada

Dr. Barbara Frisken
Simon Fraser University, Canada
Dr. Arthur Bailey
Simon Fraser University, Canada

THE INTERPLAY BETWEEN PHASE SEPARATION AND CRYSTALLIZATION OF A POLYMER-COLLOID SYSTEM IN MICROGRAVITY

Abstract

Colloids serve as model systems to study a wide range of phases and phase kinetics. The addition of polymer to colloid solutions induces an attractive depletion force between the colloidal particles and leads to a rich phase diagram where coexistence of gas-crystal, gas-liquid-crystal and gas-liquid phases is possible. One advantage of studying phase behavior in colloid-polymer systems is that the colloid-colloid interaction potential can be precisely tuned by changing the size and concentration of the polymer relative to those of the colloid. We have been investigating the interplay between gas-liquid phase separation and crystallization in colloid-polymer systems because the important role of this behavior in the development of materials including plastics and metal alloys.

In particular, we have been studying colloid-polymer samples that demonstrate gas-liquid-crystal coexistence by Small-Angle Light Scattering (SALS) experiments performed on Earth, where gravity results in sedimentation and shearing of the domains. The SALS data allows us to measure the dynamics of the initial states of the phase separation and to determine whether this phase separation is driven by nucleation or spinodal decomposition.

We have also prepared three samples that exhibit gas-liquid-crystal coexistence, which are being studied in the microgravity environment of the International Space Station. The analysis of a time series of photographs of these samples allows us to study growth of much larger structures, and, thus, maximize the extent to which the behavior can be explored. A comparison of the study of the same systems with and without gravity will provide a better understanding of the role of gravity in the interplay between phase separation and crystallization.