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Out-of-equilibrium processes in suspensions of oppositely charged colloids: liquid-to-crystal nucleation and gel formation

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We study the kinetics of the liquid-to-crystal transformation and of gel formation in colloidal suspensions of oppositely charged particles. We analyse, by means of both computer simulations and experiments, the evolution of a fluid quenched to a state point of the phase diagram where the most stable state is either a homogeneous crystalline solid or a solid phase in contact with a dilute gas. On the one hand, at high temperatures and high packing fractions, close to an ordered-solid/disordered-solid coexistence line, we find that the fluid-to-crystal pathway does not follow the minimum free energy route. On the other hand, a quench to a state point far from the ordered-crystal/disordered-crystal coexistence border is followed by a fluid-to-solid transition through the minimum free energy pathway. At low temperatures and packing fractions we observe that the system undergoes a gas-liquid spinodal decomposition that, at some point, arrests giving rise to a gel-like structure. Both our simulations and experiments suggest that increasing the interaction range favors crystallization over vitrification in gel-like structures.

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