Peculiar Thermodynamics of Interconverting Species

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Molecular and supramolecular interconversion, such as isomerization and racemization or folding/unfolding of protein molecules, is ubiquitous in nature and is commonly studied in science and engineering. In particular, it was suggested that interconversion of molecules or supramolecular structures could be a generic cause of liquid polyamorphism - the existence of multiple fluid phases in a single-component system. However, the effects of interconversion on phase transitions and phase formation have not been fully understood until recently [1-4]. Phase formation becomes drastically different if the species, whether molecules or supramolecular assemblies, interconvert. Interconversion may destroy or significantly modify fluid phase separation. If the system undergoes spinodal decomposition, evolving into the formation of equilibrium phases, the interplay between diffusion and interconversion may result in the phenomenon of phase amplification ("phase bullying"), when only one phase forms, growing at the expense of the alternative phase. In the presence of an external energy source, large enough to overcome natural interconversion, a striking phenomenon of the formation of nonequilibrium (steady-state) mesoscale structures (bicontinuous or spatially modulated) may be observed. This phenomenon is one of the simplest examples of dissipative structures in condensed matter.

References

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