2-TIPS and ordering in various active matter systems

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Abstract: 2-TIPS (Two Temperature induced phase separation) refers to the phase separation phenomenon observed in mixtures of active and passive particles which are modelled using scalar activity. Scalar activity was introduced by increasing the temperature of half of particles (labeled 'hot') while keeping the temperature of the other half constant at a lower value (labelled 'cold'). The relative temperature difference between the two subsystems is considered as a measure of the activity. We report 2-TIPS and crystallization in a system of 3-d LJ particles taken at state points spanning from gas to liquid regime using Molecular dynamics simulation (MD). From our simulations we observe that the two species tend to phase separate at sufficiently high activity ratio. We observe similar activity induced phase separation in a mixture of active and passive dumbbells. We also study the order-disorder transition and phase separation in a mixture of hot and cold spherocylinder of different aspect ratio (L/D) interacting through Weeks-Chandler-Anderson (WCA) potential in three dimensions. Activity drives the cold particles through a phase transition to a more ordered liquid crystalline (LC) state and the hot particles to a state of less order compared to the initial equilibrium state. The cold components of a homogeneous isotropic (I) structure acquire nematic (N) and, at higher activity, crystalline (K) order. Similarly, the cold zone of a nematic initial state undergoes smectic (Sm) and crystal ordering above a critical value of activity while the hot component turns isotropic. Surprisingly, activity induces LC ordering for spherocylinder having aspect ratio below Onsager limit. We find that the hot particles occupy a larger volume and exert an extra kinetic pressure, confining, compressing and provoking an ordering transition of the cold-particle domains. Finally, we show similar activity induced phase separation in a chiral system.

References:

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