Statistical Physics of Active Colloids: Phase Separation and Directed Assembly

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Self propelled colloids can undergo fluid-fluid phase separation even in the absence of attractive interactions. This is caused by their tendency to accumulate in regions where they move slowly, and move slowly in regions where they accumulate. In some cases the speed of propulsion can be controlled by a light field: this should allow one to direct the phase separation process and create what are effectively microfluidic devices from a primordial soup of active colloids. Active colloids are biomimetic of many bacteria, with the extra feature that the latter can reproduce. The interplay of population dynamics and phase separation is another route to formation of interesting structures, possibly implicated in the patterned growth of colonies at surfaces and the early evolution of the biofilm-planktonic life cycle.