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Instability and spinodal decomposition of chemically active suspensions WEN YAN, JOHN BRADY, Caltech — Chemically active particles can self-propel by diffusiophoresis with velocity $\mathbf{U} = -\mathbf{M}\nabla\mathbf{c}$ by changing the local solute concentration c via a surface catalytic reaction. Here, M is the particle dffusiophoretic mobility. The particle and fluid motion is such that the convection of solute can be ignored and the concentration field c is governed by Laplace's equation. We explore the collective dynamics of active particles by both continuum theory and particle-tracking simulation. In simulation the solute concentration field is accurately resolved simultaneously with the particles' motion by a multipole scattering method allowing the simulation of thousands of active particles. Active suspensions exhibit a Brinkman-like screening of long-range interactions which predicts an instability in the collective dynamics that scales with the volume fraction of active particles to the $1/2$ power. For weak phoretic motion (small M), the instability theory is verified by the simulations. For strong phoretic motion (large M), the active particles show a spinodal decomposition. Transient fractal structures are identified in 3D, while individual clusters are observed in a particle monolayer.

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