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Lamellar ordering, droplet formation and phase inversion in exotic active emulsions GIUSEPPE GONNELLA, Universit degli Studi di Bari, FRANCESCO BONELLI, Politecnico di Bari, DAVIDE MARENDUZZO, University of Edinburgh, ENZO ORLANDINI, ADRIANO TIRIBOCCHI, Universit degli Studi di Padova — We present the results of numerical simulations of the behaviour of a mixture of a passive isotropic fluid and an active polar nematic gel, in presence of surfactant favouring emulsification. The active stress appearing in the Navier-Stokes equation depends on the polarization field and on an activity parameter whose sign determines the contractile or extensile character of the gel. Focussing on cases for which the underlying free energy favours the lamellar phase in the passive limit, we show that the interplay between nonequilibrium and thermodynamic forces creates a range of multifarious exotic emulsions. When the active component is contractile (e.g., an actomyosin solution), moderate activity greatly enhances the efficiency of lamellar ordering, whereas strong activity favours the creation of passive droplets within an active matrix. For extensile activity (e.g., materials based on bacterial suspensions), instead, we observe an emulsion of spontaneously rotating droplets. By tuning the overall composition, we can also create high internal phase emulsions, which undergo catastrophic phase inversion when switching off the activity. Therefore, we find that activity may provide a single control parameter to design composite materials with a rich range of morphologies.

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