Coherent structures in the emulsion containing active micromotors

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The paper presents a two-phase hydrodynamic model of active motion in the emulsion containing micromotors. The liquid phase is considered as a continuum while dispersed droplets (active micromotors) are considered as separate particles exposed to the action of the active force, interacting with the liquid medium and with each other. The origins of the active forcing are not specified, so the model describes a general case that allows distinguishing of the basic patterns intrinsic to any active colloid. The interaction between phases is considered in the approximation of the Stokes law, while the interaction between active droplets is varied from elastic collisions to the alignment of droplets motion and their clustering. Numerical simulations with the use of proposed model demonstrate the generation of the coherent structures in both liquid and droplets motion. Herewith, the generated flow patterns are described well by the laws intrinsic to the developed two-dimensional turbulence. The forcing scale corresponds to the characteristic scales of active droplets interaction and the kinetic energy of active motion is distributed between the large-scale coherent structures and smaller scales where the energy is transferred to the liquid. In turn, the energy transferred from active droplets to liquid is partly dissipated due to the viscous friction and partly transferred to the larger scales generating coherent structures of liquid motion. In such a way the basic features of active colloids motion are reproduced and a new information about the flow patterns developed in active colloids is obtained. Further development of the proposed model and its parametric analysis would help to get more information useful for active colloids applications.

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