Deformation of a Droplet in Couette Flow Subject to an External Electric Field Simulated Using ISPH

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ABSTRACT

The interaction between liquid droplets with a fluid environment is one of the most common problems arising in nature and industry, particularly in emulsification, mixing and suspensions. Simulation of the behavior of droplets in linear shear has attracted much attention where either of the droplet or the background flow may be Newtonian or non-Newtonain [1–3]. Special attention has been paid to stable rotation of droplets or their breakup. Evolution of a Newtonian droplet in non-Newtonain background fluid is studied in [1, 3] while the effects of an external electric field in a Newtonian-Newtonian case is investigated in [2].

In this study, a two-dimensional Incompressible Smoothed Particle Hydrodynamics (ISPH) scheme is used to simulate the two-phase flow of a droplet in simple shear [4]. Both fluids are modeled as leaky dielectric material [5, 6]. We have carried out numerical simulations of a Newtonian droplet in non-Newtonian background flow in a recent study [3]. Here, we extend that study to evolution of droplets in linear shear while they are exposed to an external electric field. Comparison of results with those without electric field shows that it is possible to manipulate the elongation and orientation of the droplets, as suggested by [2].

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