Seminário de Mecânica

FIELD-INDUCED CONTROL OF A MAGNETIC DROP RHEOLOGY AND BREAKUP

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Abstract.

This work presents a numerical investigation of the mechanical behavior of a planar ferrofluid droplet suspended in a non-magnetic, immiscible liquid when the two-phase system is under the combined action of a shear flow and an external magnetic field. The mathematical model couples the Maxwell's equations considering the magnetostatic limit with the full, incompressible Navier-Stokes equations, taking into account surface tension and magnetic forces. The resulting fully-coupled system is accurately solved with the projection method together with the level-set approach to capture the droplet interface dynamics. The results show that the external magnetic field strongly influences the droplet deformation and its inclination relative to the flow. When viewed as a model for a dilute emulsion, the two-phase system has a reduced viscosity that is dramatically affected by the field-induced droplet distortion. Moreover, the numerical results remarkably show that droplet break-up can be controlled by adjusting the intensity and direction of the applied magnetic field. Both the rupture time and the size of the satellite (daughter) droplets are strongly field-dependent and this study identifies a set of critical field values for break-up. Notably, when the external field is perpendicular to the flow direction, it is found that the field can induce or hinder the break-up depending on its intensity range.