Seminário de Mecânica

SHEAR-INDUCED HYDRODYNAMIC DIFFUSION AND AGGREGATION IN NON-BROWNIAN DILUTE MAGNETIC SUSPENSIONS

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Abstract. In recent years, magnetic suspensions have found a number of applications. These applications are mainly due to the fact that the rheological properties of these suspensions change in the presence of an external field. In this seminar we discuss a two-particle model that we used to study transport phenomena on magnetic suspensions, like shear induced hydrodynamic diffusion and shear-induced aggregation in the regime of large Péclet numbers. In this model, we consider two identical particles free of inertia in creeping flow regime undergoing an external simple shear in the presence of dipole-dipole magnetic interactions and viscous hydrodynamic interactions between the two particles. For the numerical computation of the relative particle trajectories, we use a fourth order Runge-Kutta scheme with adaptive time step. In order to investigate the interplay between aggregative and dispersive trajectories, we use scatter diagrams to show the end position of particles coming from a starting plane and sections of a basin of aggregation to show the aggregative area given an initial configuration and the position of the starting plane of particles. In addition, we also calculate the hydrodynamic self-diffusivity, down-gradient diffusivity and the rate of particle doublet formation resulting from aggregative trajectories. The numerical computation of the diffusivities and aggregation rates are performed by the use of a Monte-Carlo integration for different values of the magnetic parameter α, which represents the non-dimensional strength of the dipole-dipole magnetic interactions. For small values of α, it was possible to fit the results for the self-diffusivity in a curve similar to the asymptotic curve for small values of roughness. Finally, based on physical scaling arguments, we propose a theory that predicts a power law dependence of the rate of aggregation as a function of the dipole interaction parameter α. These theories show good agreement with the simulation results.