TCIS
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Seminar

Non-Newtonian effects on Droplet- deformation and breakup in confined geometries: a Lattice Boltzmann study

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An important point for designing, developing and exploiting micro- and nanofluidic devices is to achieve a precise control over the process of formation of droplets, and characterization or, preferably, understanding of the scaling laws that describe the volume of droplets formed in the devices as a function of the materials and flow parameters. The confinement that naturally accompanies flows in small devices has significant qualitative and quantitative effects on the drop dynamics and break-up. Moreover, relevant constituents have commonly a viscoelastic -rather than Newtonian- nature. Setups where one is usually focusing the attention consists of confined shear flows. In this talk I will present results based on numerical simulations with the "lattice Boltzmann models" to highlight the non trivial role played by confinement and non-Newtonian effects. First we will investigate the dynamics and break-up processes of Newtonian droplets in strongly confined shear flows. We will characterize the conditions for the existence of break-up mechanisms and study the critical range of Capillary numbers at which the system transits from a squeezing mechanism into a shear-dominated droplet break-up, at changing the degree of confinement. As an upgrade of complexity, we will introduce non-Newtonian bulk properties and investigate the droplet break-up in confined geometries for Newtonian droplets in a non-Newtonian fluid matrix and the reverse case. In a real experiment all the various processes (flow parameters, viscoelastic effects, wall-induced flow modifications) occur at the same time and it is next to impossible to separately quantify their relative importance. The opportunity of the study here proposed, based mainly on quantitative numerical methods, is to allow for a systematic analysis of each of the above effects separately.

Thursday, August 7th 2014

11:30 AM (Tea/Coffee at 11:15 AM)

Seminar Hall, TCIS