Rheology of active suspensions: active rotors

Philippe Peyla, Salima Rafaï and Levan Jibuti

*Liphy, University Joseph Fourier and CNRS, Grenoble, France**

In this work, we conduct a numerical investigation on sheared suspensions of active particles on which a torque is applied: rotors. Particles are spherical, non-colloidal, mono-dispersed and neutrally buoyant. Sice the torque modifies particles rotation, we show that it can indeed strongly change the effective viscosity of semi-dilute or even more concentrated suspensions. We perform our calculations up to a volume fraction of 28%. And we compare our results to data obtained at 40% by Yeo and Maxey[1] with a totally different numerical method. Depending on the torque orientation, one can increase (decrease) the rotation of the particles. This results in a strong enhancement (reduction) of the effective shear-viscosity of the suspension. We construct a dimensionless number Θ which represents the average relative angular velocuty of the particles divided by the vorticity of the fluid generated by the shear flow. We show that the contribution of the particles to the effective viscosity can be suppressed for a given and unique value of Θ independently of the volume fraction. In addition, we obtain a universal behavior (*i.e.* independent of the volume fraction) when we plot the relative effective viscosity divided by the relative effective viscosity without torque as a function of Θ. Finally, we show that a modified Faxén law can be equivalently established for large concentrations

References

[1] Yeo and Maxey, Phys. Rev. E **81**, 62501 (2010)

*Electronic address: Philippe.Peyla@ujf-grenoble.fr