Particle diffusion at fluid/fluid interfaces

Alma J. Mendoza-Lugo†, Raquel Chulia-Jordan‡*

Instituto Pluridisciplinar
Paseo Juan XXIII, n. 1; E-28040 Madrid, Spain
†ajmenlu@quim.ucm.es
‡rchulia@pas.ucm.es

ABSTRACT

Particle laden interfaces are important as environmentally friendly systems for stabilizing emulsions and foams. However, their dynamics at liquid/liquid interfaces has been Sheldon studied [1-3]. We have measured the mean-square displacement (MSD) of latex microparticles (1.0, 2.9 and 5.7 μm of diameter) at the water/octane interface at liquid-like particle densities, and at different temperatures. Two different experimental techniques, were used: a) one of the passive type (particle tracking), and b) one of the active type (optical tweezers). Both techniques have been set-up within the MULTIFLOW project.

The results show that only for very low particle densities the motion of particles is Brownian, whereas, even at relatively low densities, a subdiffusive behavior is found. Also subdiffusive dynamics was observed for a single particle within the potential well of the optical trap. Figure 1a shows a typical trajectory for a microparticle inside the trap, in all the cases studied the MSD is much smaller than the particle diameter. Figure 1b shows the time dependence of MSD for a very low particle density (diffusive), and for a higher density (subdiffusive). The results have been successfully modeled using a Langevin equation that contains a Hookean force term. The diffusion coefficients obtained have a 1/R dependence (R is the particle radius), and an Arrhenius-like temperature dependence.

ACKNOWLEDGMENTS: The work has been supported by MULTIFLOW_ITN (E.U. Framework Program VII).

References

