DIFFUSION COEFFICIENT OF A FERROFLUID-WATER SYSTEM IN A HELE-SHAW CELL

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Experimental studies of complex phenomena observed in ferrofluids (e.g., magnetic micro-convection [1]) require a good understanding of the intrinsic properties and behavior of the ferrofluid used. Here we examine a simple mixing of water and ferrofluid droplets that are brought to contact in a Hele-Shaw cell. With bright field microscopy, we film the diffusion process over time and obtain magnetic particle concentration fields from acquired images via Beer-Lambert law. Following a concentration profile of a sample line perpendicular to the diffusion front shows an unforeseen nonsymmetrical development (see figure). In addition, it gives much greater diffusion length augmentation than expected from Fick's law for a colloid of the average particle size of around 10nm. We reveal the causes of these differences, by using simulations of the model system, and compare results with control measurements of sample parameters that are obtained by standard techniques (Magnetization, Birefringence, Dynamic Light Scattering and Forced Rayleigh Scattering measurements). In addition, we discuss the differences in the obtained measurement results and their causes.

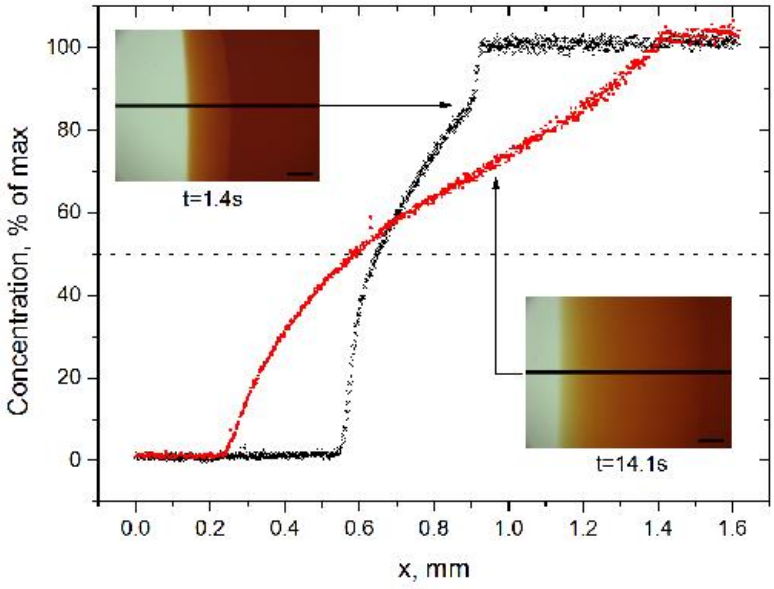

Figure: Ferrofluid concentration distribution over sample lines (long dark lines in bright field images) at two different times, during diffusion mixing. Dark short lines in images are scale bars that correspond to 0.2 mm.

Reference

[1] Erglis, K., et al.: J. Fluid Mech., 714 (2013), p. 612.