

Viscous Properties of Ferrofluids from Dynamic Light Scattering

B. Rathke^S, J. Patzke, S. Will^C

Technische Thermodynamik, Universität Bremen, Bremen, Germany
swill@uni-bremen.de

Ferrofluids are stable dispersions of nano-sized subdomain magnetic particles [1]. The application of an external magnetic field increases the effective viscosity of the fluid (magnetoviscous effect). At high particle concentrations this effect is attributed to the formation of predominantly chainlike structures in the dispersion.

We have investigated the magnetoviscous effect in ferrofluids using two complementary techniques of Dynamic Light Scattering (DLS). Capillary Wave Spectroscopy (CWS) optically probes thermally excited surface waves and allows the measurement of viscous properties without an external shear stress [2, 3] that may otherwise influence the microstructure of the sample. For the successful application of the technique to ferrofluids the design of a homogeneous magnetic field and of susceptibility-matched sample-containers that strongly reduce surface-curvature were essential. Results are presented for magnetite-based ferrofluids under magnetic fields of different strength and orientation, which demonstrate the anisotropy of viscous properties.

Corresponding classical DLS-measurements from the bulk of the fluid in connection with fiber-optic detection (FOQELS) [4] provide diffusion coefficients that can be related to the size of structures formed. CWS results are discussed in terms of these results.

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