Orientational ordering and diffusivities in an electric-field induced homeotropic phase

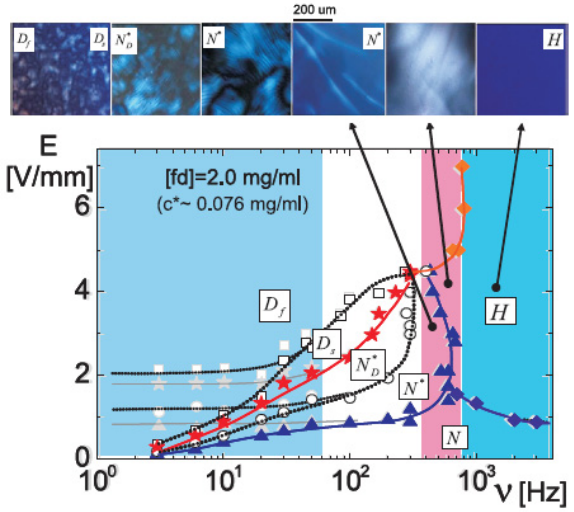
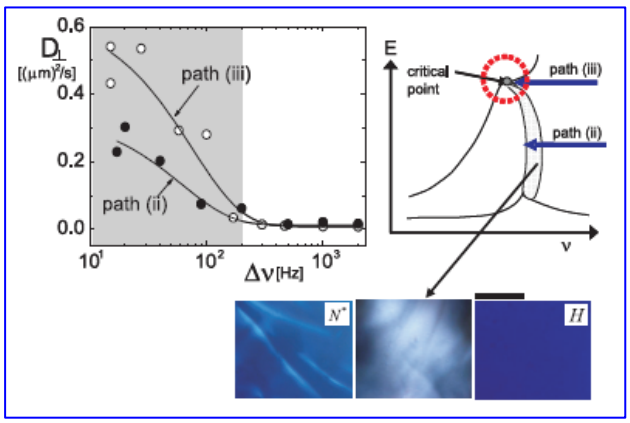


Fig.1: The phase/state diagram in the electric-field amplitude-versus-frequency plane, with depolarized images of the various states.

Various phases and dynamical states are observed in suspensions of long and thin colloidal rods (fd-virus particles) as the result of interactions between the charged rods through the polarization of electric double-layers and the layer of condensed ions, electro-osmotic flow, as well as the association/dissociation of condensed ions. Polarization charges are absent at frequencies above ~0.7-1 kHz, where the phase diagram quite abruptly changes (see Fig.1), and beyond which frequency a homeotropic state is exists. This state is stabilized solely by hydrodynamic interactions through electro-osmotic flow. The interest here is the orientational order and diffusivity within this H-phase. Orientational order is measured by means of electric birefringence along different paths within the amplitude-versus-frequency plane (see Fig.2). The orientational order parameter is found to be independent of the field amplitude and frequency (see Fig.2). Dynamic light scattering experiments within the H-phase show that diffusion coefficients are also constant throughout the H-phase, except within the region indicated in pink in Fig.1 (see Fig.3), where large pre-transitional nematic domains exists (see the second most right image in Fig.1 and the middle image in Fig.3). However, unusual dispersion curves are also found, where the decay rate of intensity correlation functions does not vary linearly with the squared scattering wave vector (see Fig.4), depending on the fd-concentration and ionic strength.



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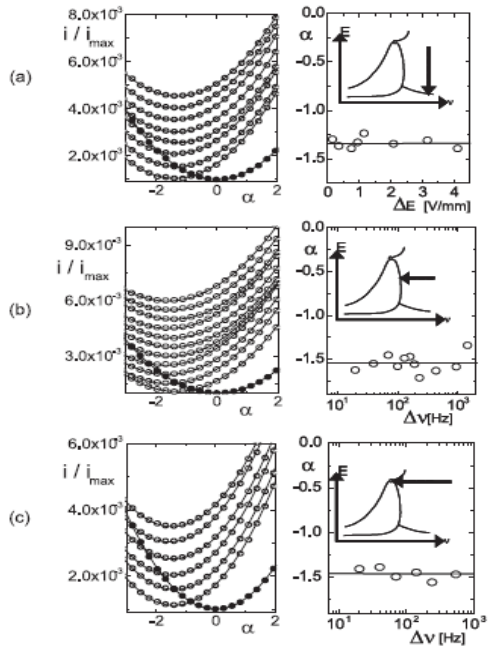

Fig2.: Left: Measurements with a null-birefringent set up, where the transmitted intensity is determined as a function of the angle of the polarizer. The optical phase shift is obtained from the angle where the minimum transmitted intensity is observed. Right: the paths in the H-phase along which the various measurements have been performed.

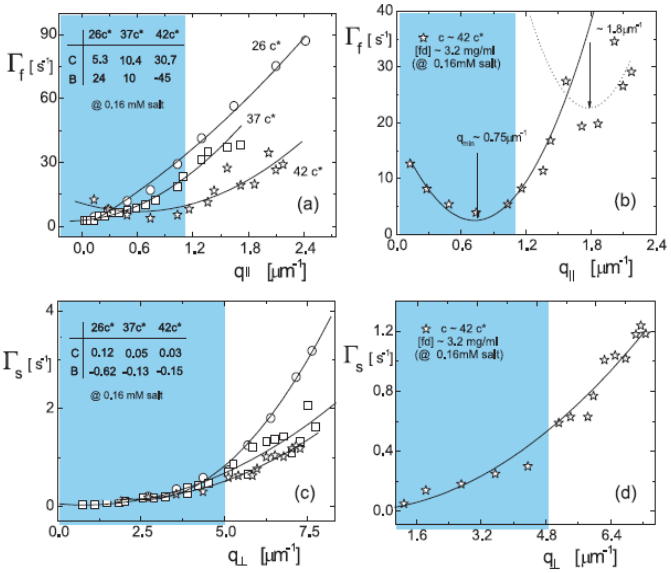

Fig.4.: Dispersion curves for several fd-concentrations and ionic strengths for diffusion parallel (upper panel) and perpendicular (lower panel) to the nematic director of the H-phase.

Fig.3.: The diffusion coefficient for motion perpendicular to the nematic director. Within the region corresponding to the arrow to the middle image (indicated also in Fig.1 by the pink area), the measured diffusion coefficient increases on lowering the frequency as a result of the formation of pre-transitional blurry nematic domains.