

Phase diagram of colloidal suspensions of magnetic nanoplatelets

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Suspensions of magnetic nanoplatelets in isotropic solvents are very interesting examples of ferrofluids. It has been shown that above a certain concentration such suspensions form ferromagnetic nematic phase [1], which makes this system a unique example of a dipolar fluid. The formation of the ferromagnetic nematic phase (Fig. 1) is driven by screened anisotropic electrostatic and long-range dipolar magnetic interactions. Barium hexaferrite (BHF) nanoplatelets are ferrimagnetic, having the easy axis of magnetization perpendicular to the platelet's plane. The crucial component of the suspension besides the BHF nanoplatelets is dodecylbenzenesulfonic acid that forms a double layer around the nanoplatelets and provides for their colloidal stability in alcohol. The total fraction of the dodecylbenzenesulfonic acid controls the parameters of the electrostatic interactions between the BHF nanoplatelets [2].

Here, we present the phase diagram for the ferromagnetic nematic phase formation of the dodecylbenzenesulfonic-acid-modified BHF nanoplatelets dispersed in 1-butanol. The phase behaviour is evaluated using polarized optical microscopy, with which we distinguish between birefringent ferromagnetic nematic phase and optically isotropic paramagnetic phase. We study the effect of different parameters, such as platelets' size, the strength of magnetic interactions and strength and screening of electrostatic interactions on the phase behaviour of the suspension. The phase diagram is determined by changing experimental parameters, such as the concentration, the size distribution of the nanoplatelets, their magnetization and the amount of the dodecylbenzenesulfonic acid in the suspensions.

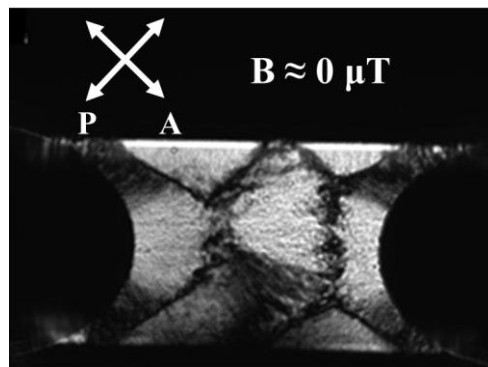


Figure 1: Polarized optical microscopy image of magnetic domains in a highly concentrated colloidal suspension of magnetic nanoplatelets.

References

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