INTERACTION EFFECTS IN NON-POLAR FERROFLUIDS BY SMALL-ANGLE NEUTRON SCATTERING

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Small-angle scattering of non-polarized neutrons is applied to reveal the character of the interparticle interaction in ferrofluids. The scattering structure-factor reflecting this interaction is analyzed as a function of the volume fraction of the dispersed magnetic material. Two types of ferrofluids are studied. They are sterically stabilized dispersions of magnetite in non-polar carriers (benzene, cyclohexane) and polar (pentanol) carriers stabilized by non-ionic (oleic and myristic acids) and slightly ionic (dodecylbenzenesulphonic and lauric acids) surfactants, respectively. The considered ferrofluids are highly stable, no reflections of aggregate formation are seen in them in the absence of external magnetic field. Non-polar ferrofluids are single layered, while in the case of pentanol-based ferrofluids, the double layer of the surfactants is realized. A significant difference between the two types with respect to the structure-factor effect in non-magnetized samples is observed. In the non-polar fluids the interaction effect on the scattering is small even for comparatively high concentrations of magnetite (> 5 vol.%), while in polar fluids it starts to be visible since 1 vol.%. One can assume that this can be explained by the principle structural difference connected with the double layered organization of the surfactant shell in polar fluids, where the particle volume fraction is higher for the same amount of magnetite. However, estimates of the effect basing on simple repulsive models for the interaction including the hard sphere approximation and the local monodisperse approximation show that the magnetic attraction between particles should be also taken into account. This problem for highly polydisperse systems is discussed. Qualitatively, in non-polar systems the repulsive hard sphere interaction neglecting the magnetic attraction fails to fit the observed scattering. In polar ferrofluids the stabilizing layer is thicker and the steric repulsion prevails over the magnetic attraction, so that the behavior of the particles at small concentrations is close to that of non-interacting hard spheres. Possibilities for studying interaction effects in fluids under magnetic field are considered.