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Electric field-induced assembly of magnetic nanoparticles in ferrofluids

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Stimuli responsive materials, which can self-assemble depending on the environment, are of great interest. In this context nanoparticles offer unique opportunities as they can be custom designed and it is very important to understand the assembly mechanisms to control the resulting structures, which is crucial for the synthesis of materials with controllable properties. It is well known, that properties of ferrofluids can be controlled by external magnetic field. However, inhomogeneous distribution of magnetic particles in non-polar ferrofluids was observed recently under external electric fields and formation of large aggregates was concluded in such systems. And it was also concluded, that electric fields, similar to magnetic fields, could be a driven force to induce the assembly of magnetic nanoparticles (MNPs) in bulk and at the interface.
Thus, it was shown by SANS that aggregation process depends on the electric field strength. Impact of temperature on such aggregation was also concluded according to SANS experiments. Maximum changes in the magnetic structures of the particles under application of both magnetic and electric fields were observed by SANSPOL. Assembling of MNPs from non-polar ferrofluid on a planar surface and further evolution of the interface structure under electric field application were studied by NR. The reason of the observed effects is related to the polarization of the particles in the electric field and their interaction as dipoles.

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