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Capillary interactions between silica-particles in organic solvents[1]

GARFIELD WARREN, DOBRIN BOSSEV, Indiana University — Small-angle neutron scattering (SANS) is used to study the interactions of silica nano-particles with an average diameter of 10 nm in methanol and methanol/toluene mixtures at 25 ^{o}C. SANS intensities are analyzed as a product of a form factor and a structure factor. The form factor is experimentally determined in methanol after addition of simple electrolyte at a concentration of 100 mM to suppress the interparticle interactions. The data is successfully fitted by Hayter-Penfold mean spherical approximation (HPMSA) that yielded the specific area of surface charge in methanol. The phase behavior, viscosity and interparticle interactions are studied as a function of fraction of toluene in methanol/toluene mixtures at a constant particle volume fraction of 3.7 %. At intermediate fractions of toluene, between 44 and 65 %, the viscosity increases by two orders of magnitude which suggests formation of two dimensional network of silica particles. Computer simulations of a pearl necklace-like chain of spheres is conducted to explain the structure factor at these intermediate fraction of toluene. The capillary force is thought to be the driving force for the network formation. To verify this hypothesis, anionic and cationic surfactants are tested to disintegrate the particle chains.

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Dobrin Bossev
Indiana University

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