INTERNAL STRUCTURE OF SILICA SOL-SYNTHETIC POLYAMINES COLLOID-POLYELECTROLYTE FLOC COMPLEXES

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The structure of colloid-polyelectrolyte flocs formed by silica sol and synthetic polyamines has been studied at the difractometer "Membrana-2".

The problem of flocculation seems to be — along with a practical importance for organization of waste — free productions — the most challenging problem in colloid chemistry. So far we have not sufficient information about the internal structure of colloid-polyelectrolyte complexes.

This work was intended to study the distribution of silica sol (SS) particles inside the colloid-polyelectrolyte complexes (CPEC) formed by SS and poly-N,N' — dimethylaminoethylmethacrylate (PDMAEMA) by means of the small-angle neutron scattering (SANS) method.

The mixture of H_2O — D_2O (18 *vol.%* D_2O) has been used as the dispersion fluid. This mixture will match the scattering density of polymer and therefore cancel the SANS of the polymer.

The SANS surves obtained for the CPEC are shown in fig.1. Here a SANS curve for air-dried SS sample is also given for comparison. The SANS curves obtained can be divided into the three parts: the initial part ($0.002 \leq 2\Theta \leq 0.014$ where 2Θ is the scattering angle), the region of weakly expressed diffraction maximum and the terminal part with the slope fitting the law $I(Q) \sim Q^{-4}$, where Q is the length of the scattering angle. Such kind of curves seems to favor the current opinion that the scattering system has a fractal structure [1,2].

The initial parts of curves 1 and 2 have been processed with the help of relation $I(Q) \sim Q^{-D}$, where D is the mass fractal dimension [3]. The solid curve shown in fig.1 is a fit to the experimental data, the best fit was obtained for $D = 2.2$. This result strongly suggests that the regions of the high concentration of silica particles inside the flocs are alternated with the regions of their low concentration.

The Bragg's type maximum on the scattering curves indicates that the distribution of silica particles inside the regions wigh their high concentration is ordered. The average distance between silica particles in these regions is $L = 14.7$ *nm* (assuming that the particles form the compact hexagonal packing).

The pronounced diffraction maximum on the diffractograms is observed for the air-dried SS sample (fig.1, curve 3) and for the 30% SS solution as well (these data are not given). And for air-dried sample $L = 19.8$ *nm*, for the 30% solution $L = 13.8$ *nm*. L being less than for the 30% solution for the air-dried sample is likely to be due to the occurence of a thin polymer layer between silica particles inside the flocs.

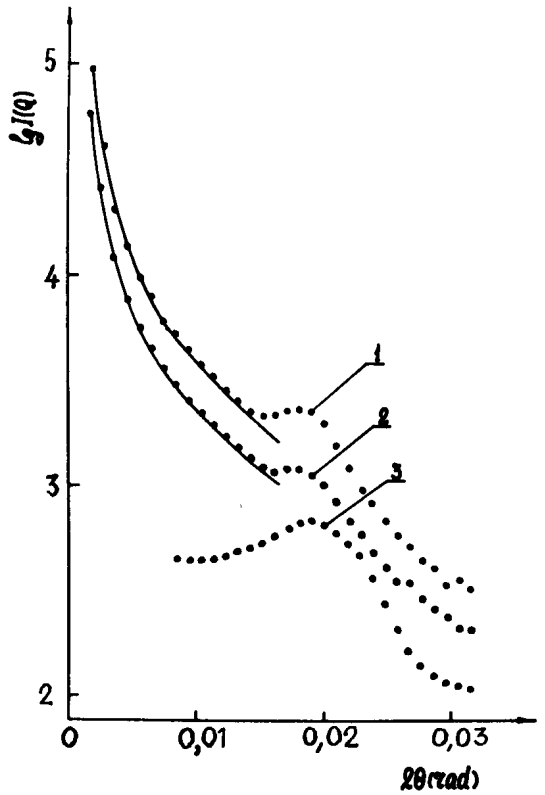

Fig. SANS curves: *1,2* — for SS particles inside flocs (1—pH = 3, 2—pH = 9), *3* — for air-dried silica sol

Then the linear dimensions of ordered regions ("domains") are assumed to be about 3—5 diameters of silica particles and do not exceed 10—12 diameters otherwise we should observe the secondary maxima which are typical for the scattering from homogeneous balls.

Thus, we came to the conclusion that CPEC feocs formed by SS and PDMAEMA have inhomogeneous structure. The ordered regions ("domains") inside the flocs have the dimensions about 3—5 diameters of silica particles. Inside the "domains" SS particles form a compact packing. Average distances between the centers of silica particles inside the "domains" are great as compared to an SS cample. This fast strongly suggests that no direct contacts between silica particles occur. Neighbouring "domains" are connected with each other by means of silica particles' chains. It leads to the formation of fractal structure with the dimension of fractal $D = 2.2$.

References

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