DRYING OF AQUEOUS SESSILE DROPLETS OF COLLOIDAL SUSPENSIONS ON BASE OF NANOPLATELES OF LAPONITE RD® WITH ADDITIVES OF POLY(ETHYLENE OXIDE)

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Aims: Investigation of the drying of aqueous sessile droplets and electrosurface properties of colloidal suspensions based on nanoplatelets of Laponite RD® (Lap) with additives of poly(ethylene oxide) (PEO).

Materials: Laponite RD® (Rockwood Additives Ltd., UK) (Lap), poly(ethylene oxide) PEO4000.
The mass ratio was $X=m_{Lap}/m_{PEO}$, and the concentration of Lap was varied in the range of 0.05–4.0 wt%.
The Methylene Blue was used for better visualization of such colloidal suspensions ($m_{MB} = m_{Lap}/400$)

Characterization: The entire drying system, including microbalance EW120-4NM (Kern&SohnGmbH, Germany) and digital photo camera Hayear HY-6300 (Guangdong, China), was placed into a TS-80M-2 thermostat (JSC Medlabortekhnika, Ukraine). The electrokinetic measurements were also performed (ZetaSizer Nano ZS instrument (Malvern, United Kingdom)).

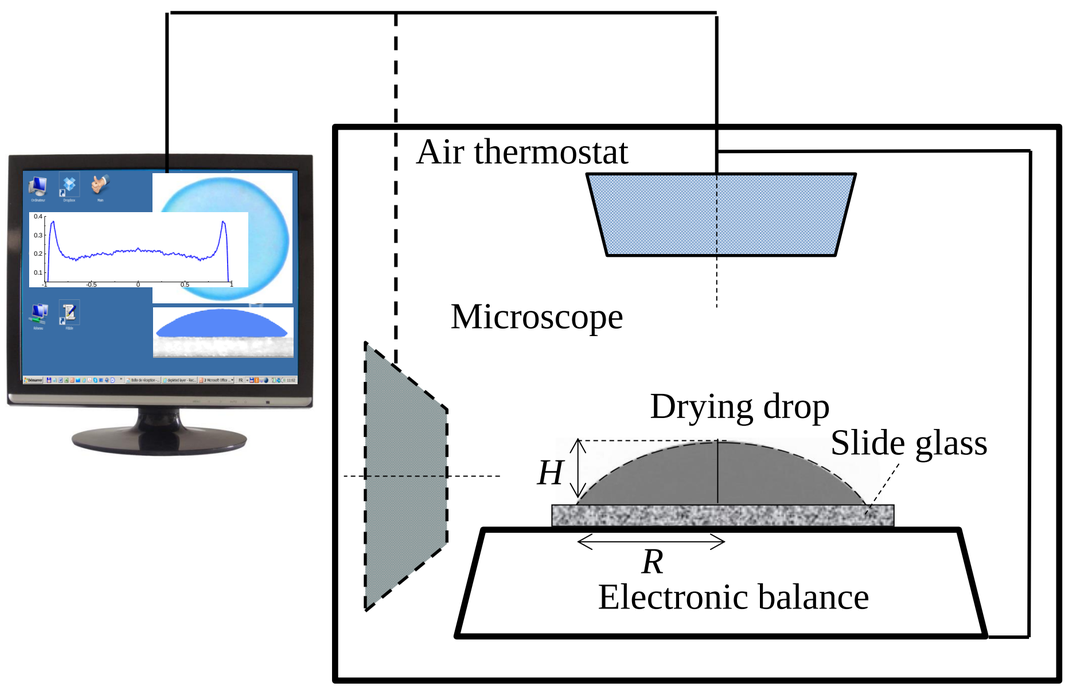

Fig. 1 Scheme of the drying sessile droplet setup for continuous measurements of the changes in the mass and geometrical profiles.

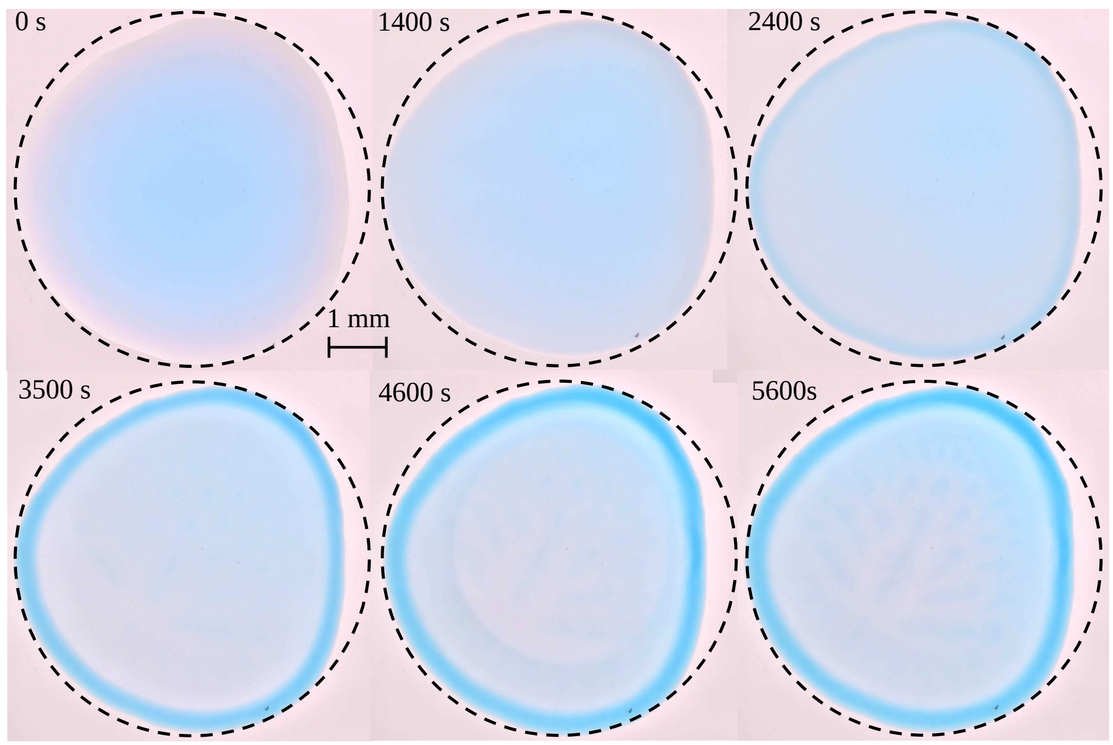

Fig. 2 Examples of time changes of horizontal patterns during the drying of sessile droplet at different drying times for Lap+PEO suspension at C_{Lap}=0.5% and X=1.0.

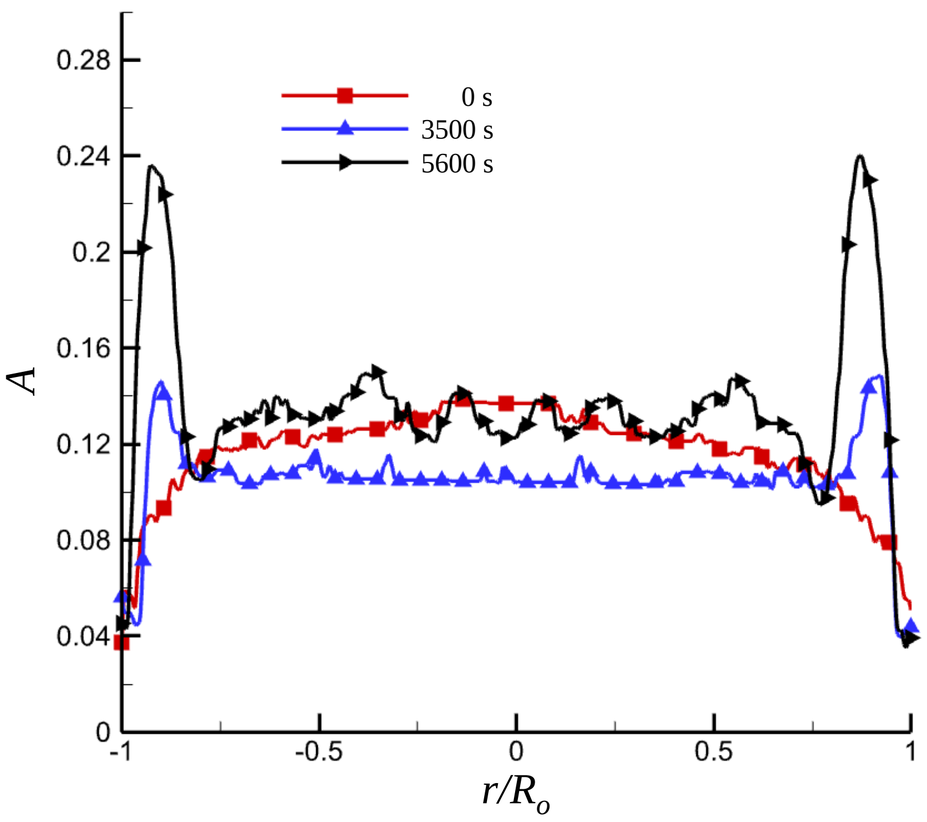

Fig. 3 Light absorption radial profiles $A(r/R_0)$ during the drying of sessile droplet at different drying times for Lap+PEO suspension at C_{Lap}=0.5% and X=1.0.

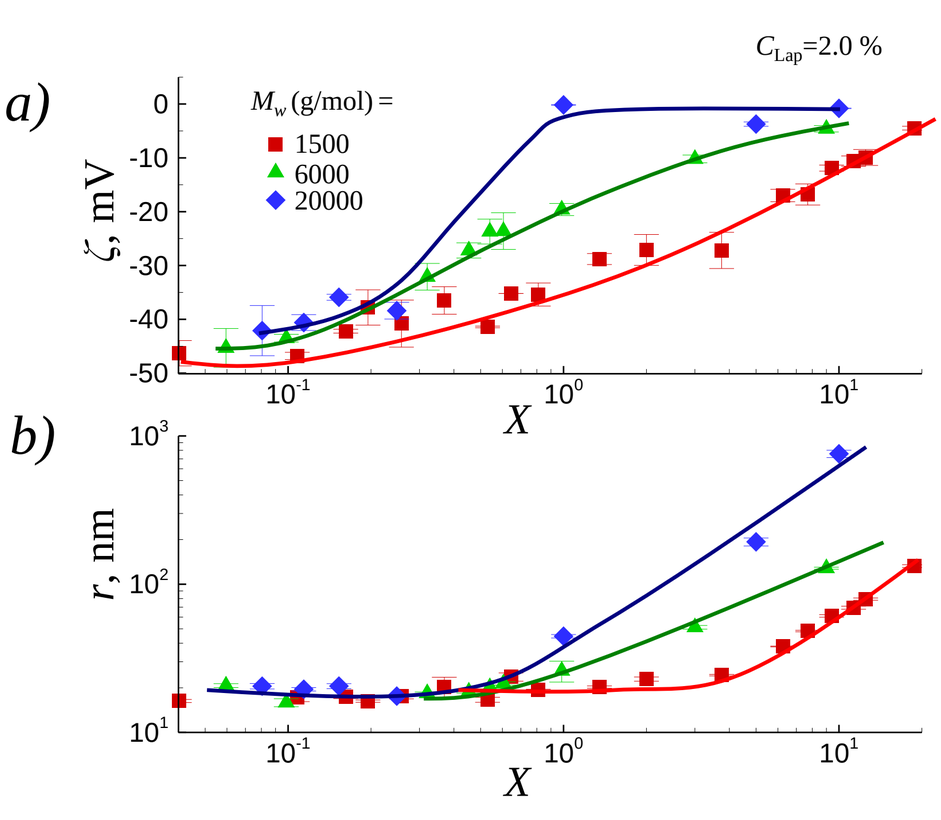

Fig. 4 The ζ-potential of Lap particles (a) and radius of aggregates, r, (b) versus the relative concentration of PEO, X for PEO with different molecular masses, M_w. The concentration of Lap was C_{Lap}=2 %. Symbols are experimental data, and solid lines are to guide the eye.

Conclusions

Drying of sessile droplets of binary colloidal aqueous mixtures of platelets of Laponite® RD and PEO has been studied.

- During the drying the processes of redistribution of the dispersed particles were observed.
- Formation of the three different zones was observed: a) central zone of the almost transparent round “enlightenment”; b) outer “gray” ring; c) thin “coffer” ring at the external boundary.
- For C_{Lap}=2.0 % the PEO additive noticeably influences the spatial distribution of Lap particles. The effects of bridging of Lap particles by PEO become more evident for high values of M_w. It resulted in decreasing the ζ-potentials and provoked formation of big aggregates.