Evaporation of nanosuspension droplets

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Spreading and evaporation of nanoparticle suspensions plays a very important role in technologies such as ink-jet printing. These phenomena are affected by the deposition of nanoparticles on the solid, the so-called coffee-ring effect, and by the adsorption of the particles at the liquid/vapor interface.

In this work we have studied the evaporation of aqueous suspensions of slightly hydrophobic polystyrene latex nanoparticles (PS-NP), and of hydrophobized silver nanoparticles (Ag-NP). We have used four different solid substrates: Teflon®, PET, PEN and glass, the first three being hydrophobic and the last one hydrophilic. For the sake of comparison we compare the results with the behaviour of solutions of a superspreader and of the suspensions of silica nanoparticles previously reported. We have also studied the Ag-NP suspensions after the addition of a surface active co-solvent. The systems under study cover a broad range of behaviors: silica nanoparticles do not adsorb at the L/V nor at the S/L interfaces; PS-NP slightly adsorb at the L/V but not at the S/L, and Ag-NP and also the superspreader strongly adsorb at both interfaces.

The experimental results have been compared with the predictions of a recent theory proposed by Semenov et al. for pure fluids [1]. Surprisingly the agreement for the first stage of the evaporation process is very good despite being suspensions of particles, surfactant solutions or mixtures of nanoparticles and a surfactant. The same behaviour has been found irrespective of their adsorption at any of the two interfaces.

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[1] S. Semenov et al., *Langmuir*, 2013, **29**, 10028.