

Behaviour of Polymer-Nanoparticle Binary System at Air-Water Interface

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This study considers the formation and collapse of polymer-silica nanoparticle films at the air-water interface in the presence of aqueous electrolyte. The adsorption of poly(vinylpyrrolidone) (PVP) polymer onto silica was studied using Quartz Crystal Microbalance with Dissipation monitoring (QCM-D). Subsequently, the static surface tensions of air-PVP solutions were measured by Pendant drop. These two experiments were then used as a baseline to understand phase transition isotherms obtained at the air-water interface with a Langmuir trough for the binary polymer/particle films.

The QCM-D study indicates that after 4 rinses the surface excess is reduced to an equivalent value, $\Gamma = \sim 3\text{-}5 \text{ mg/m}^2$, forming a compact, dense layer at the solid-liquid interface. The Pendant drop results show that the addition of a salt (0.55 M Na₂SO₄) increases the surface activity of PVP in its theta solvent. On the basis of those, compressional (π -A) isotherms indicate that combining the polymer and nanoparticles at the interface in a sequential manner appears to provide adsorbed films with a tendency to loose material during compression. In the case of nanoparticles pre-coated with the polymer a strong interfacial adsorption is observed resulting in robust compressible films. This typically indicates a broad applicability for the stabilization of foams and emulsions.