Electronic Supplementary Material (ESI) for Physical Chemistry Chemical Physics.

Supporting Information

Flow Effects on the Surface Properties of Surfactant Foam Films

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For our model, there are many parameters (e.g., film length, film height, slip length, salt concentration, surface density, activity coefficient and equilibrium constant, etc.), which have some influence on the surface properties. Here we discuss the effect of parameters on the results.

The influence of film size on the results

The size of the film segment in the model is an adjustable parameter. Here, we set the thickness of the film at 60nm, which is ten times larger than the Debye length, ensuring that double layers would not overlap. We compare the case for film lengths setting as 200nm, 400nm and 700nm, and the calculated zeta potentials at different pressure drops are shown in the **Figure S1**. As seen, the values of zeta potential are not same at different film lengths, but the trend of amplification of the zeta potential is similar, indicating that the choice of film length have litter influence on our study.

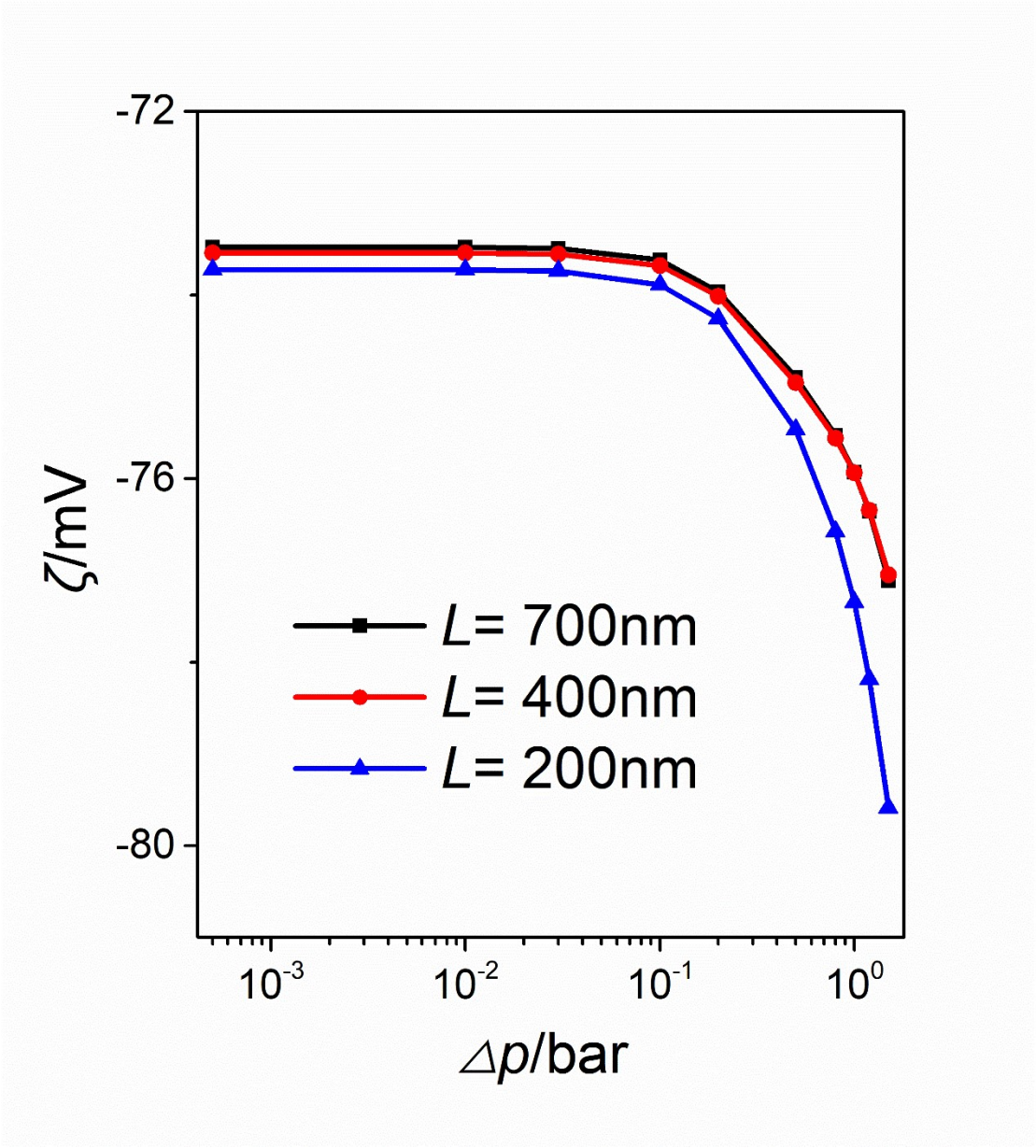

Figure S1. The zeta potential versus pressure drop for three film lengths.

The influence of slip length on the results

The slip flow would affect the surface properties of the film. The slip length is an adjustable parameter. Here we set the slip length as 5nm, 7nm and 10nm, then calculate the zeta potential of the films at different pressure drops. As shown in the **Figure S2**, the values of zeta potential are not same at different slip lengths, but the

trend of amplification of the zeta potential is similar, indicating that the choice of slip length have litter influence on our study.

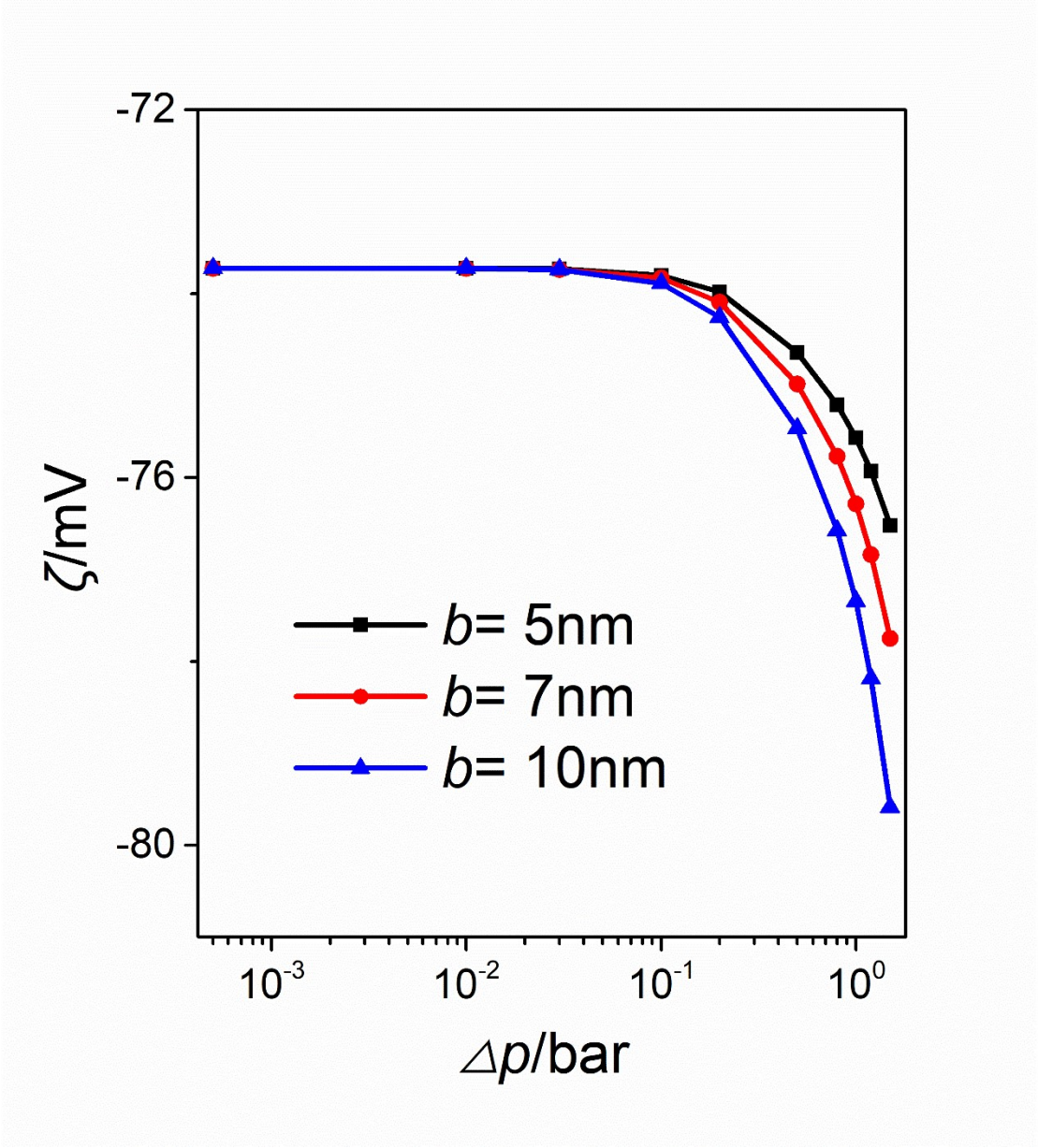

Figure S2. The zeta potential versus pressure drop for three slip lengths.

The influence of activity coefficient on the results

In this study, the salt concentration is low, so the activity coefficient can be calculated by the Debye-Huckel's limiting equation: $\ln \gamma_{\pm} = Az_{+}z_{-}\sqrt{I}$, in which

$A = \frac{e^3 N_A^{1/2} \rho_s^{1/2}}{4\pi\sqrt{2}(\varepsilon kT)^{3/2}}$. When solvent set as water at 25℃, A is around 1.1709 $mol^{-1/2} \cdot kg^{1/2}$.When the salt concentration c_s=0.068M, the ionic activity coefficient $\gamma_{\pm}$ is around 0.7369. The choice of ionic activity would also affect the result of electrostatic properties. We set the activity coefficient as 0.74, 0.90 and 1, then calculate the zeta potential of the films at different pressure drops. The result is shown in the **Figure S3**. As seen, the values of zeta potential are not same at different conditions, but the trend of amplification of the zeta potential is similar, indicating that choice of activity coefficient have litter influence on our study.

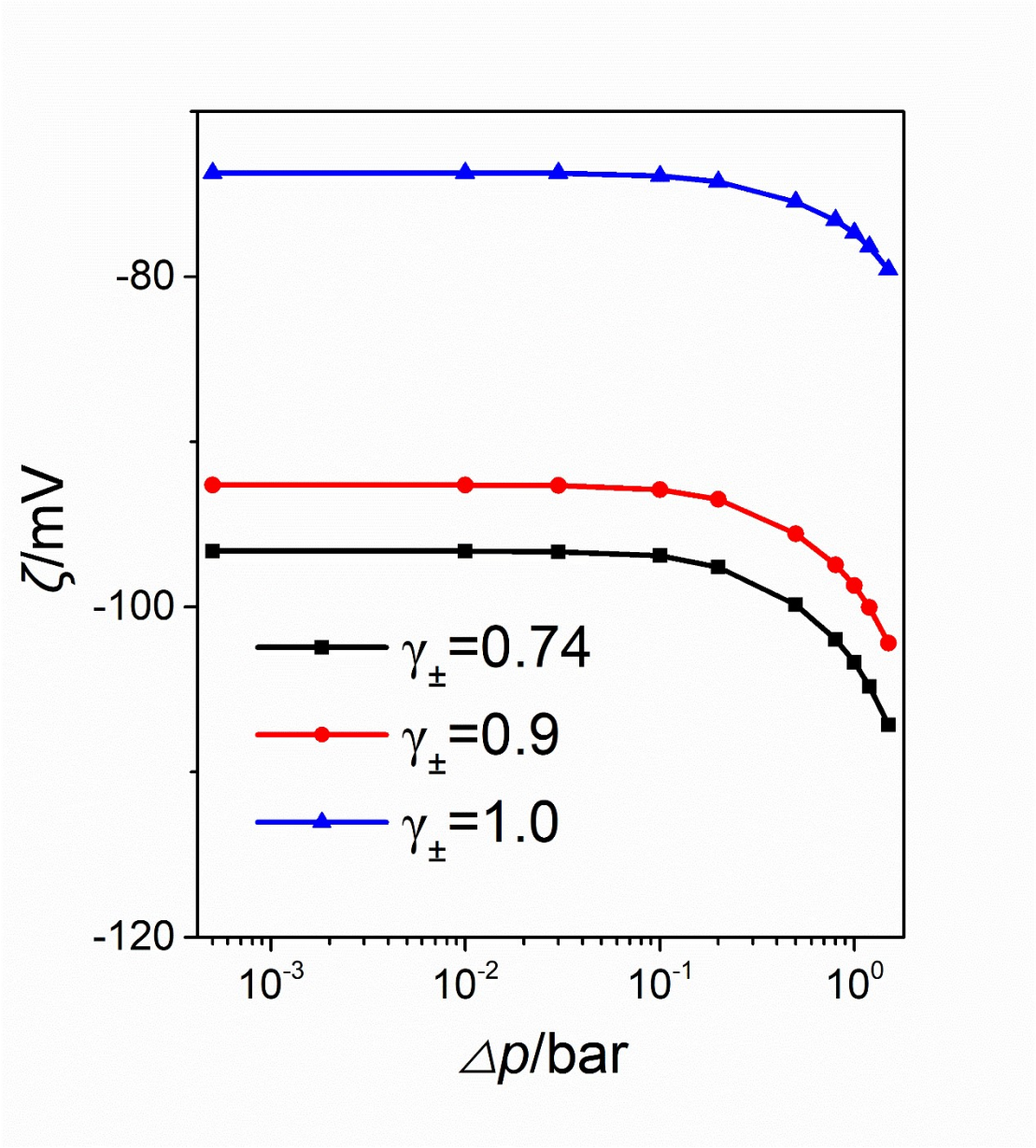

Figure S3. The zeta potential versus pressure drop for three activity coefficients.

The influence of the equilibrium constant on the results

We treat the ions binding as a simple adsorption reaction. The adsorption equilibrium constant is usually obtained by Langmuir isotherm. For the system we studied, there is no exact equilibrium constant, while the equilibrium constants of similar systems with surfactant and salt are in a relatively wide range. The choice of

the equilibrium constant would affect the result of electrostatic properties. We set the equilibrium constant as 0.023, 0.035 and 0.050, then calculate the zeta potential of the films at different equilibrium constants. As shown in the **Figure S4**, the values of zeta potential are not same at different film lengths, but the trend of amplification of the zeta potential is similar, indicating that the choice of film length have litter influence on our study.

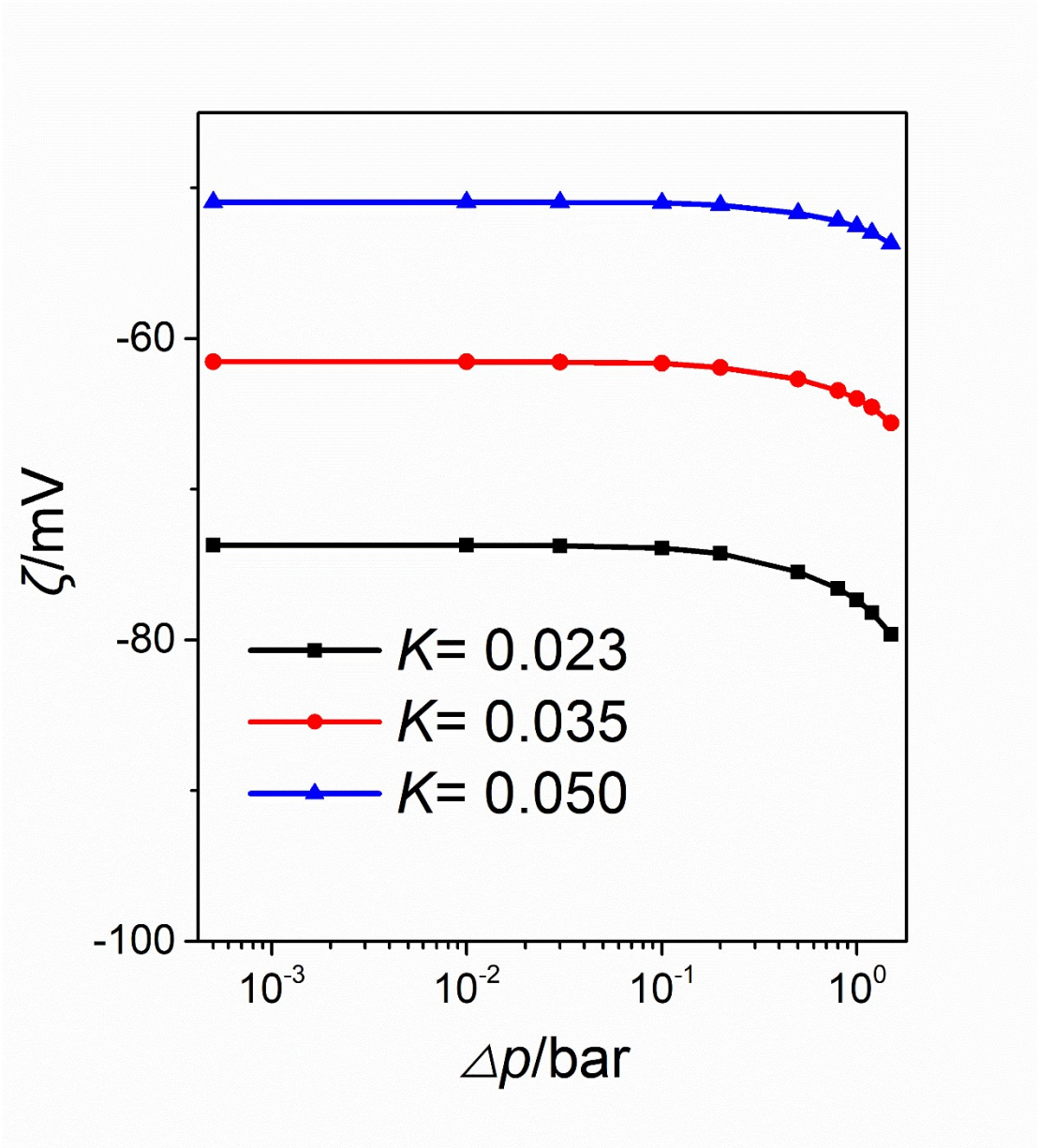

Figure S4. The zeta potential versus pressure drop for three equilibrium constants.

It can be seen from above analysis that the selection of parameters in this model would affect the exact values of zeta potential and surface charge, but it would not affect the trend of electrostatic properties of the film. In addition, these results also show that if there are more accurate parameters, we can obtain more accurate zeta potential by this model.