

Opposites attract in Soft Matter: Mechanisms and Applications

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Recent studies have pointed the importance of electrostatic assembly in the elaboration of innovative nanomaterials [1]. Beyond their structures, many important questions on the thermodynamics of association remain to be answered. Here, we investigate the complexation between oppositely charged polymers chains using a combination of different techniques, isothermal titration calorimetry (ITC), static and dynamic light scattering and electrophoresis. Upon addition of polycation to polyanion the results obtained by the different techniques reveal a two-step process [2]. The primary process is the formation of highly charged polyelectrolyte complexes of sizes 100 nm. The secondary process is the transition towards a coacervate phase made of rich and poor polymer droplets. The binding isotherms measured are accounted for using a phenomenological model that provides the thermodynamic parameters for each reaction. Small enthalpies and large positive entropies consistent with a counterion release scenario are found throughout this study. Applications of the above strategy to other charged nanosystems, including inorganic nanoparticle [3], natural organic matter [4] or phospholipids [5] have shown strong similarities with polymer complexation. Beyond, this work stresses the importance of the underestimated formulation pathway or mixing order in charged systems [1].

[1] J.-P. Chapel and J.-F. Berret, *Curr. Opin. Colloid Interf. Sci.* **17**, 97-105 (2012)

[2] L. Vitorazi, N. Ould-Moussa, S. Sekar, J. Fresnais, W. Loh, J.-P. Chapel and J.-F. Berret, *Soft Matter* **10**, 9496-9505 (2014)

[3] F. Mousseau, L. Vitorazi, L. Herrmann, S. Mornet and J.-F. Berret, *J. Colloid Interf. Sci.* **475** 36-45 (2016)

[4] F. Loosli, L. Vitorazi, J.-F. Berret and S. Stoll, *Water Research* **80**, 139-148 (2015)

[5] F. Mousseau, E. Seyrek, R. Le Borgne and J.-F. Berret, *Langmuir* **31**, 7346-7354 (2015)