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Fine-tuning protein phase transitions: a TR-USAXS and VSANS study

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Multivalent cations induce complex phase transitions in negatively charged globular proteins, e.g. reentrant condensation and liquid-liquid phase separation [1] with a lower critical solution temperature (LCST-LLPS) [2] featuring a strong dependence on the type of multivalent cations used [4]. Improved opportunities at large-scale facilities allow for detailed studies of the kinetics of LCST-LLPS in the above systems with complementary VSANS and TR-USAXS [3,4] in the low- q region down to $4 \times 10^{-5} \text{ \AA}^{-1}$ [5,6], resolving even big structures. Here, we present a systematic TR-USAXS and VSANS study of the kinetics of phase separation in protein-cation systems with varying interprotein interaction strengths. At low temperatures and with weak interactions, the temperature-dependent characteristic length scale of phase separation ξ grows as a function of time as $\xi = (2\pi)/q \sim t^{1/3}$. Increasing the interprotein interaction strength leads to strong deviations from this classical growth behaviour. We therefore show that an appropriate choice of the multivalent cations used can finetune phase transitions in protein systems.

- [1] Zhang et al., Pure Appl. Chem. 2014 (86), 181-202
- [2] Matsarskaia et al., JPCB 2016 (120), 7731-6
- [3] Da Vela et al., Soft Matter 2016 (12), 9334
- [4] Matsarskaia et al., in preparation, 2018
- [5] Pipich & Fu, JLSRF (1), 2015
- [6] Van Vaerenbergh et al., AIP Conference Proceedings 2016 (1741), 030034

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