

Phase separation and colloid interaction induced by selective solvation in aqueous mixtures

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The solvation effects have been studied microscopically in chemistry, but they are universally relevant on mesoscopic spatial levels. This is because solutes such as ions or hydrophobic particles can easily induce composition and density heterogeneities in aqueous systems. We have recently investigated how solute particles interact selectively with water and other less polar components. The typical interaction free energy much exceeds $k_B T$ per particle. As a result, solute and water molecules are mostly in a strong coupling state. In this lecture, I will discuss phase separation, mesoscopic structure formation, and colloid interactions induced by the selective solvation.

The figure below shows mesoscopic composition patterns in aqueous mixtures induced by a small amount of hydrophilic cations and hydrophobic anions. This pattern remains stationary giving rise to anomalous scattering, as observed by Sadakane *et al.*

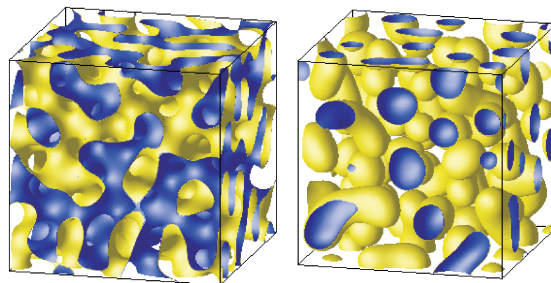


FIG. 1: Mesoscopic composition patterns in aqueous mixtures with antagonistic salt, where the average water composition is at the critical value (left) or is relatively small (right).

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- [2] R. Okamoto and A. Onuki, *PRE* 82 (2010) 051501; 84 (2011) 051401.
- [3] K. Sadakane, H. Seto, H. Endo, and M. Shibayama, *J. Phys. Soc. Jpn.* 76 (2007) 113602; K. Sadakane, A. Onuki, K. Nishida, S. Koizumi, and H. Seto, *PRL* 103 (2009) 167803; K. Sadakane, N. Iguchi, M. Nagao, H. Endo, Y. B. Melnichenko, H. Seto, *Soft Matter* 7 (2011) 1334.