Adsorption of Janus particles to curved interfaces

Dept. of Chemistry, Tokyo Metropolitan Univ. Yuichi Hirose*, Shigeyuki Komura
Dept. of Chemistry and Chemical Engineering, Yamagata Univ. Yoshimune Nonomura

球状のJanus粒子の球状の液・液界面への吸着について理論的な解析を行った．粒子の平衡での接触角が粒子表面のジオメトリ，それぞれの部分の濡れ性，そして界面の曲率によって決定されることを示す．一様な表面の粒子の場合とは対照的に，Janus粒子はある条件を満たす場合に自発曲率を持つことが分かった．

Particles which have two distinct parts are called "Janus particles" in the name of the dual-faced Janus god. By providing two different chemical and/or physical properties to a single particle, one can produce various kinds of Janus particles which are useful in many modern technologies. Here we focus on the Janus particles which are analogous to surfactant molecules having both hydrophilic and hydrophobic parts. Such amphiphilic particles were obtained by Casagrande *et al.* from glass spherical particles[1]. They studied the adsorption of the Janus particles at oil/water interfaces, and showed that they behave differently from ordinary solid particles.

It is well known that homogeneous surface particles stabilize emulsions. Such emulsions are called Pickering emulsions[2, 3]. The adsorption of such homogeneous spherical particles to a liquid-liquid interface was investigated before[4]. In particular, we looked at the effect of the curvature of the interface on the particle adsorption. We showed that although the equilibrium contact angle is determined by the classical Young's equation (being independent of the curvature), the adsorption energy is affected by the interfacial curvature.

We report a similar analysis for Janus particles[5]. We first discuss their equilibrium position at a liquid-liquid interface, and examine the effect of the interfacial curvature. Due to the inhomogeneous nature of the Janus particles, they exhibit completely different adsorption behavior compared to the homogeneous particles. Especially, we show that there is a preferred curvature (spontaneous curvature) in the presence of a Janus particle when certain conditions are satisfied. This property is in sharp contrast compared with the homogeneous particles for which the spontaneous curvature does not exist.

*E-mail:hirose-yuuiti@ed.tmu.ac.jp

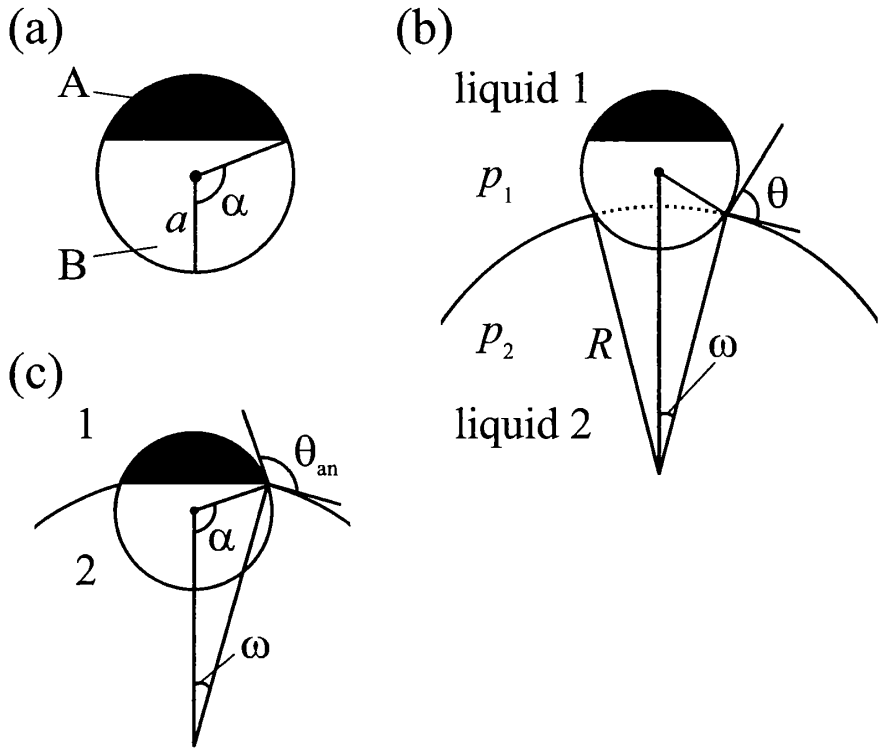

Figure 1: An illustration of a Janus particle and their adsorption to curved liquid-liquid interface.

References

[1] C. Casagrande, P. Fabre, E. Raphaël, and M. Veyssié, Europhys. Lett. **9**, 251 (1989).

[2] S. U. Pickering, J. Chem. Soc. **9**, 2001 (1907).

[3] B. P. Binks, Curr. Opin. Colloid Interface Sci. **7**, 21 (2002).

[4] S. Komura, Y. Hirose, and Y. Nonomura, J. Chem. Phys. **124**, 241104 (2006).

[5] Y. Hirose, S. Komura, and Y. Nonomura, to be published in J. Chem. Phys.