

Surface force properties of polystyrene latex particles in ionic surfactant solutions

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ポリスチレンラテックス粒子は粒径の分散が非常に小さいためモデル粒子として多く用いられている。しかし、高分子で形成された粒子であるためその表面の構造には多様性がある。本研究ではイオン性界面活性剤水溶液中におけるラテックス粒子表面層の特性を調べる目的で、コロイドプローブ法を用いた表面力測定を行った。対照実験で行ったシリカ粒子での結果と比較すると、シリカ粒子では、表面に界面活性剤分子の吸着層が存在するが、ラテックス粒子では顕著な吸着層構造が観察されず、吸着した界面活性剤分子が表面層に侵入し、構造変化を起こし表面力特性を変化させていることがわかった。

1 Introduction

Colloidal dispersions of polystyrene latex spheres are important in industrial process and have also been widely studied as model colloids. Surface structures and properties of the particles, which determine the physical properties of the latex, have been investigated; In particular, the behaviour of the polymer chain at the surface region in various solutions is focused and has been studied. Surface force measurement using an atomic force microscope (AFM) is one method to obtain directly the force as a function of the separation between two surfaces. We investigated the surface forces between a polystyrene particle ($R = 5 \mu\text{m}$; negative charged surface) of latex and a flat silica plate in several concentrations of aqueous solution of ionic amphipathic molecule (hexadecyltrimethylammonium bromide; CTAB) by using AFM colloidal probe method [1]. Our purpose of this study is to reveal the surface structure and property of polystyrene particles from the surface force profiles.

2 Results and Discussion

The force-separation relationship in 5mM CTAB solution is shown in Fig. 1. Surface force between a silica particle ($R = 3.6 \mu\text{m}$) and a flat silica plate in the same condition is also shown [2]. At large separations, an electrical double-layer repulsive force was detected in both of the

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systems, which was induced by the charges of the adsorbed CTA^+ . On the other hands, at smaller separations, the surface force profiles were different from each other. For the silica particle, a jump-in phenomenon was observed at ca 6nm separation, an arrow in Fig.1, because of the adsorbed CTA^+ layers on both surfaces squeezed out by the pressure. For the polystyrene particle, instead of the jump-in phenomena, the repulsive force increased monotonously at separations closer than about 10nm. Linear force-separation relationship indicates that there would be a 10nm thick elastic region at the surface of the polystyrene particle. This elastic region may correspond to a hairy layer, which controlled the latex behaviour reported for many latex systems [3].

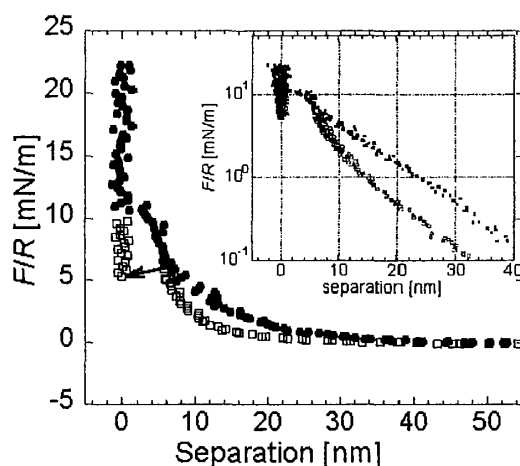


Figure 1: Normalized forces, F/R , between a polystyrene particle and a flat silica plate ($\bullet$), and between a silica particle and a flat silica plate ($\square$) in 5mM CTAB as a function of surface separation. Inserted figure shows the same on a logarithmic scale.

References

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