2元系コロイド結晶の成長メカニズム
Growth mechanism of binary colloidal crystals

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Colloidal crystals have been attracted great attention from wide application fields owing to their unique optical properties. Now, varieties structures of the colloidal crystal, e.g. non-closed packed structure, are significantly demanded for diverse applications. For this ends, to grow binary colloidal crystal is promising method since it displays rich structural diversity. However, in contrast to single component system, growth mechanism of binary system of colloidal crystals is poorly understood. Also, to grow large size of binary colloidal crystals with high crystallinity is still difficult. In this study, in-situ observation is conducted to reveal detailed growth process of binary colloidal crystals. Then, growth mechanism is discussed.
Polystyrene particles are employed in the experiment. Green fluorescent particles with 500 nm and red with 700 nm are employed. Crystallization of colloidal crystals is induced by depletion attraction.
We have found several features on the growth of binary colloidal crystals. First, it grows on substrate. The AB_2 structure (A: 700 nm, B: 500 nm) is found to be grown by utilizing crystals composed only of 700 nm particles. The AB_2 crystals also grow on crystals of 500 nm. The specific crystallographic orientations between those crystals are recognized. Combination of orientations between AB_2 and substrate are classified into four types. Heteroepitaxial growth is found to occur for growth of AB2 structure. Second, growth rate of binary colloidal crystals is quite small compare to that of single component system under the same particle concentration. We think this is attributed to complex structure of the crystals, which requires each particle incorporating to their own site. This process is not required for crystals composed of single component. Third, cluster formation at the interface is recognized. The ordered structure composed only of 500 nm is formed at growing interface. Particles of 700 nm is incorporated into the ordered structure generates AB_2 structure.
These observations provide great hints to reveal overall growth mechanism of binary colloidal crystals, which will lead to establish sophisticated growth technique to grow large and high quality crystals.

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