〈技術資料〉

高分子微粒子の粒子径制御法と中空ナノ粒子への応用

Size Control of Polymer Particles and Synthesis of Hollow Nanoparticles

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Abstract

The nucleation and growth processes of polymer particle in soap-free emulsion polymerization (SFEP) were observed in-situ on the molecular scale using atomic force microscopy (AFM). Using cationic water-soluble initiators, all polymer materials generated in the bulk could be electrostatically adsorbed onto the mica surface. From the AFM images of the adsorbents, the followings are found; the polymer materials are continuously generated in the bulk throughout the SFEP, contributing to the particle growth. Therefore, the particle size increased with the initiator concentration. Furthermore, SFEP of aromatic vinyl monomer using oil-soluble initiators was studied for the synthesis of micron-sized particles with the addition of an electrolyte to enhance hetero-coagulation rate for particle growth. When SFEP was carried out using melamine foam, gel, micro spaces between glass beads to prevent the coagulation between the particles during their growth periods, the polymer nano particles were able to be synthesized without surfactant. When absorbing azo compounds by polymer particles, heating enabled the hollow structures inside them because of the forming nitrogen gas decomposed from the azo compounds. These methods enabled environmental loads to be reduced for the synthesis of various polymer particles in soap-free system.

キーワード：核生成、成長、AFM、ソープフリー乳化重合、粒子径制御
Keywords: Nucleation, Growth, AFM, Soap-free emulsion polymerization, Size control

1.　緒言

高分子微粒子はセラミックなどの無機微粒子と比較すると、表面形態や化学構造の制御が容易であり均一なものを量産しやすい特長をもつ。この特長を活かし、塗料、接着剤[1)]、繊維などの工業分野から、ドラッグデリバリーシステムの医療分野、トナーや液晶パネルスペーサーの情報分野まで広範に渡って利用される。これらの微粒子を材料とする製品の特性は、微粒子の表面形態・特長、均一度や分散・凝集状態などの微粒子性状に影響される。製品の品質の向上には微粒子自身の物性をコントロールすることは極めて重要な事項であり、本稿ではその粒子径と形態の制御法について解説する。

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2.　高分子微粒子の生成・成長メカニズム

高分子微粒子の生成と成長のメカニズムを明らかにするためには、それらの過程を分子レベ