Spherical porous polymer particles prepared by phase inversion emulsification process

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Polymer particles with micrometers size have attracted attention due to their potential applications in modifiers of cosmetics, additives of toners, rheology control agents of paint, diagnostic testing agents for medical treatment and automotive materials. In particular, porous polymer particles are a favorable candidate for their applications because of their low-specific-gravity and large apparent surface area. In this study, we demonstrate that spherical porous polymer particles can be prepared by a combination of a phase inversion process from W/O emulsions to O/W emulsions and a removal process of water-soluble organic solvents, and discuss about the effects of surfactants and poor solvents on the formation and porous structure of polymer particles.

A MEK solution of poly(styrene-co-acrylonitrile)(SAN) was mixed with an aqueous solution of copoly(vinyl alcohol-vinyl acetate)(PVA) to prepare W/O emulsions. The sufficient PVA aqueous solution was successively added under a vigorous stirring to induce the phase inversion from W/O emulsions to O/W emulsions. The total volume of water phase was 0.8~1.6 times as much as that of oil phase. Here, since the subsequence addition of water causes exuding water-soluble MEK predominately from the surface of the oil droplets in O/W emulsions, we can obtain solidified SAN particles.

Fig.1(a) shows representative scanning electron micrograph (SEM) images of the solidified SAN particles without porous structure prepared at a stirring rate of 500 rpm. The resultant particle size was about 4μm. It was found that the size distribution is improved by adding hydrophobic surface-active agents having low HLB into the oil phase or by increasing the stirring rate. Further, we found that the addition methylcyclohexane (MCH), which is a poor solvent of SAN, into MEK resulted in the formation of various shape of SAN particles. We successfully prepared disc-like (Fig.1b) and porous (Fig.1c) SAN particles at MEK/MCH=8/2 and MEK/MCH=7/3, respectively.

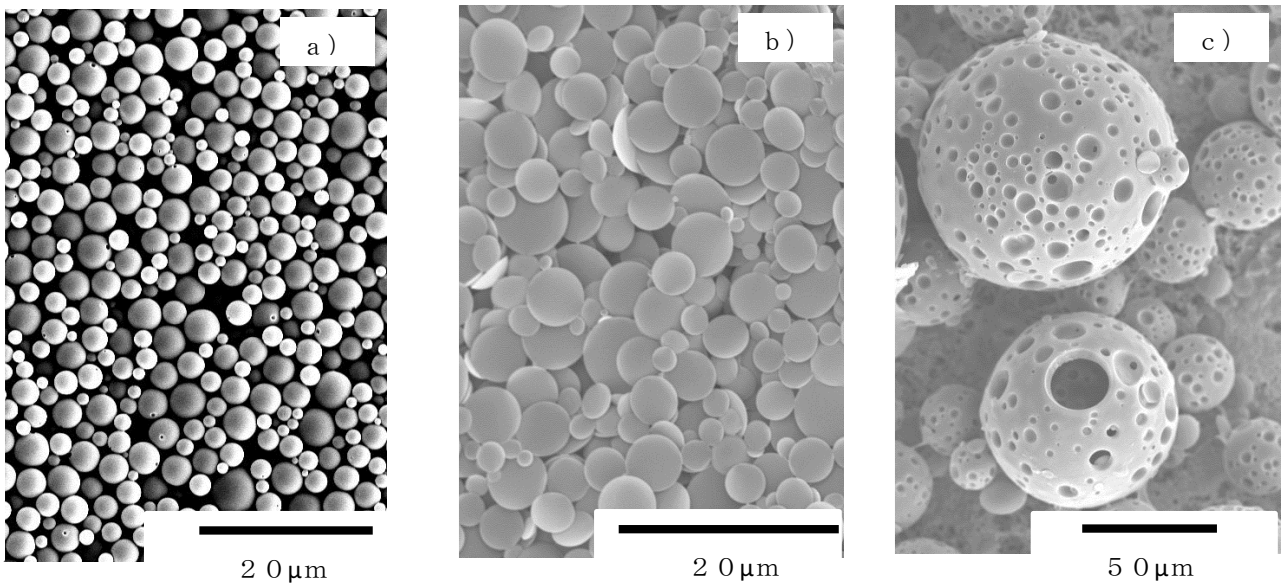

Fig.1 SEM images of (a) spherical SAN particles, (b) disc-like SAN particles, and (c) SEM porous SAN particles.