Electrically conductive polyaniline-coated polystyrene latex particles

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Near-monodisperse, micrometre-sized electrically conductive polyaniline-coated polystyrene latex particles have been synthesized[1,2,3] with the help of surfactant from aqueous solution and suspended in acidic solution. A cathodic voltammetric wave was observed in the aqueous suspension of mono-dispersed spherical polyaniline-coated polystyrene latex particles, whereas no anodic wave was detected. These variations were common to the particles with eight different sizes ranging from 0.2 to 7.5 μm in diameter. This irreversibility cannot be found at polyaniline-coated electrodes, and hence is a property of the dispersion of the polyaniline latex. The reduction current was controlled by diffusion of dispersed particles rather than adsorbed particles. The reduction efficiency as high as 80-90 % is ascribed to the electric conducting state of PANI of which inner potential can take the same potential over the shell as the electrode potential when the particle comes in contact with the electrode. In contrast, the oxidation, which proceeds with the propagation of conducting zone, takes a long time during which the Brownian motion lets the particle be detached from the electrode. The number of the loaded aniline units per particle, determined by weight analysis, ranged from 6×10^6 (ϕ 0.2 μm) to 3×10^{11} (ϕ 7.5 μm). It was proportional to 2.9 powers of the diameter of the latex sphere. The diffusion-controlled current of the cathodic wave was proportional to 2.4 powers of the diameter. The difference in the power, 0.5, agreed with the theoretical prediction of the diffusion-controlled current of which diffusion coefficient was evaluated from Stokes-Einstein's equation. This presentation reports the voltammetric conversion of polyaniline-coated polystyrene latex particles dispersed in aqueous acid solution in order to find not only a relationship between the partial reaction and particle size, but also the irreversibility of the conversion.

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