Electrode reactions of catechol at tyrosinase-immobilized latex suspensions

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Tyrosinase was immobilized on the polystyrene latex particles with micron size in order to control amounts of the enzyme. The tyrosinase-coated latex particles were composed of the core polystyrene and four successively coating layers: the polystyrene sulfonate, the polyallylamine, the tyrosinase and the polyallylamine, by the layer-by-layer technique (as shown in Fig. 1). These particles were dispersed well in aqueous solution because of the ionic properties of the surface. They showed catalytic currents of the enzymatic oxidation of catechol to *o*-quinone. The enzymatic activity per latex particle was evaluated to be 2.3×10^{-7} units from UV absorption of *o*-quinone

The current vs. time curve is shown in Fig.2, where the current was at 0.09 V. It is predicted that o-quinone generated from catechol by the enzymatic reaction is reduced electrochemically. The enzymatically catalytic reaction was illustrated in Fig.1B.

Fig.3 shows variations of the steady-state current with concentrations of catechol, c_c, at some unit values of TYR-coated latex. The current increased in proportion to c_c less than 20 μM, and saturated at high concentrations. The current values are independent of concentration of TYR-coated latex, $[E_o]$ for $c_c < 35$ μM, and fall on a common curve. As the value of the units is smaller, the current deviates at a lower value of c_c. In other words, currents at larger values of c_c are controlled by $[E_o]$ because of shortage of tyrosinase.

The relation between the catalytic current and the concentration of catechol followed the kinetic equation predicted from Michaelis-Menten relation. The particles adsorbed once on the electrode were not desorbed in latex-free solution, and exhibit the catalytic activity.

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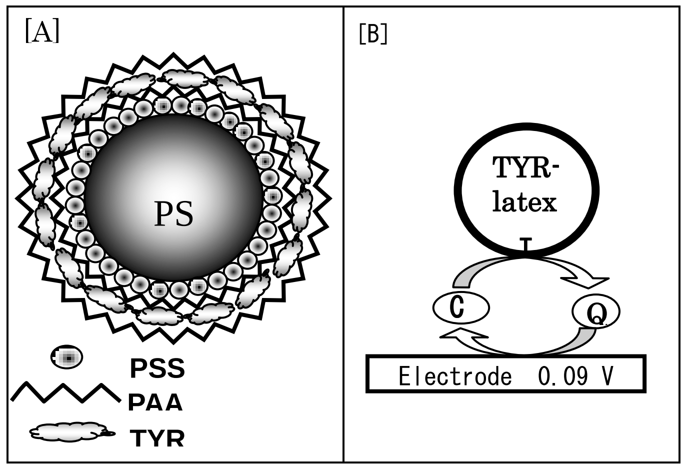

Fig.1 [A] Illustrative layer-by-layer structure of the TRY-coated polystyrene latex particle. The core is the polystyrene latex, the surface of which is coated with polystyrene sulfonate (PSS), polyallylamine (PAA), tyrosinase and PAA, successively. [B] Reaction scheme of catechol with the TYR-latex particles.

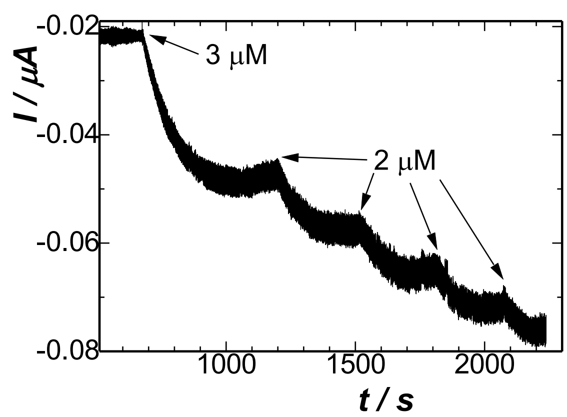

Fig.2 Current-time curve at 0.09 V in the TYR-coated latex suspension with 258 units cm^{-3} of the buffer solution when 10 mM catechol was added successively. Air-saturated phosphate buffer solution pH 6.8, initial volume 2 cm^{-3}. Convection conditions.

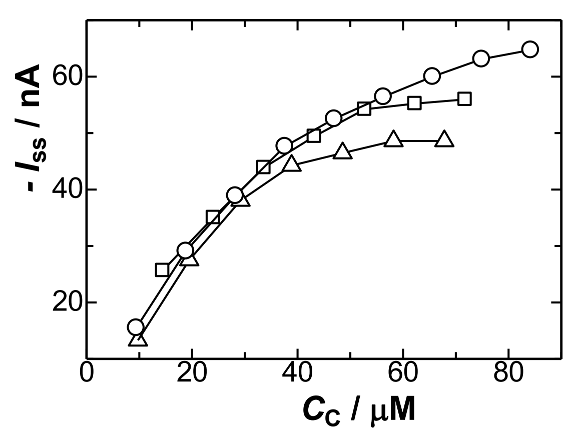

Fig.3 Variations of the steady-state current with concentrations of catechol, c_c, at TYR-coated latex of which unit numbers are (triangles) 174, (squares) 258 and (circles) 404 units cm^{-3}. Air-saturated phosphate buffer solution pH 6.8