

Properties of Prussian blue encapsulated in the cavity of ferritin L134P mutant

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Ferritin¹ is a ubiquitous iron storage protein in mammals bodies. It consists of 24 monomer subunits to form a spherical hollow structure. We have succeeded in synthesizing Prussian blue (PB) incorporated in the cavity of ferritin L134P mutant (FrL134P). The composite of PB with the ferritin mutant (PB@FrL134P, Figure 1) showed high solubility to aqueous media. In addition, the inherent instability of PB in alkaline solution was effectively improved for PB@FrL134P; the degradation rates were 10^3 times slower at pH 9 and pH 10 than that of colloidal PB prepared conventionally. The result suggested that the ferritin cavity imparts the tolerance under alkaline conditions to PB by the enclosure with the protein shell. In analogy with the colloidal PB, PB@FrL134P showed catalytic activity in the oxidation reaction of 3,3',5,5'-Tetramethylbenzidine (TMB) in the presence of H_2O_2 . The lower pH of the solution was preferable to the higher catalytic performance of PB@FrL134P.

The UV-Vis spectra of PB@FrL134P showed reversible peak shifts in the IVCT band of PB@FrL134P depending on the solution pH. The treatment of PB@FrL134P with KCN suppressed the catalytic activity. These observations suggested that PB in PB@FrL134P was enriched at vacant coordination sites on iron ions occupied by water molecules, and these vacant sites were associated with the enhanced catalytic activity of PB@FrL134P.

The complete digestion of PB@FrL134P with proteinase K resulted in the recovery of PB species accompanied by a residual peptide. Despite the exposure to bulk solution, the recovered PB species maintained the high stability to alkaline solutions and the catalytic activity. This result suggested that the interior PB was protected by the protein shell in addition to the isolation from bulk solution, possibly through the interaction with amino acid residues located in the inner surface. The peptide interacted with interior PB will be identified by the study in progress.

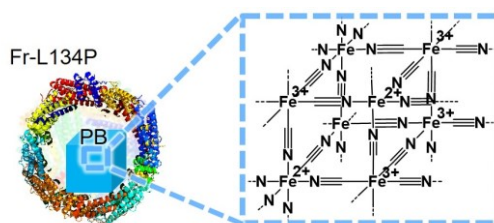


Figure 1. PB@Fr-L134P

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