睦月セミナー

Controlling a Reversible Self-Assembly Path by Nanoscale Metal Surface

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Abstract

Self-assembly of amyloid beta peptide (Aβ) is a crucial step of the fibrillogenesis, which is considered as an onset hallmark mechanism of Alzheimer's disease. We have succeeded to reproduce an oligomer formation of $A\beta_{1\text{-}40}$ monomers over the nanogold colloidal surface as an external pH was changed between pH 4 and pH 10. Under pH 4, unfolded $A\beta_{1\text{-}40}$ monomer constructed a dimer or trimer based oligomeric form with hydrophobic segment placing outward. On the other hand, a conformation of Aβ constructed under pH 10 consists of a folded monomer with hydrophilic segment folded inward avoiding the networking with residual colloidal particles. While amyloid beta was attached to both silver and gold surface, more polarizable silver surface was found to restrict the channel of unfolding process. There was specific size/temperature dependence in a reversible self-assembly. Over 20 nm gold colloid, a reversible assembly process of $A\beta_{1\text{-}40}$ monomer was observed in the temperature range of 5 °C and up to 65 °C. When 30 nm or 40 nm gold colloids were used a reversible self-assembly was observed below 5 °C. Most probable oligomer form constructed over 20 nm gold colloidal surface is dimer based unit and that over 30 or 40 nm gold colloidal surface is concluded to be a trimer based unit. However, self-assembly was not successfully reproduced under the rest of conditions. A significant enhancement of a reversible self-assembly was achieved when a surface environment of gold colloid was functionalized with dibenzyloxy disulfide. The highest effect was obtained when electron donating group was used in para-substitution. It implies that electron density was more concentrated to the bonding between disulfide group and gold surface resulting a weaker interaction between Aβ monomers and a functionalized group. A weaker bonding enabled to cause a flexible structural change between folded and unfolded forms.

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