Reactivity and structual change of protectant-substituted Ag nanoplates with DNAs

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Silver nanoparticles and nanocolloids are widely used in the daily products nowadays due to their specific antibacterial property. In this regard, study of their reactivity for biomolecules such as DNAs has attracted much attention whether they can treat safely or not. In this study, we have examined the reactivity of Ag nanoplates, which are known as intrinsic high reactive nanomaterials due to their specific structure, with DNAs. The nanoplates were prepared by photoreduction method and protectant-substituted ones were prepared by using thiolate molecules. Their reactivity with DNAs were evaluated by fluorescent spectroscopy using fluorescence intercalator.

Ag trianglular nanoplates protected by PVP (poly(vinylpyrrolidone)), Ag:PVP, were synthesized by photoreduction of $AgNO_3$ with PVP molecules reported previously [1,2]. The obtained nanoplates were mixed and stirred with D-penicillamine for 24 hours[3]. The obtained precipitation was rinsed by ethanol, and was dispersed into water. This dispersion was observed by optical and IR absorption, and BF-STEM (bright-field scanning transmission electron microscopy). Additionally, this dispersion was mixed with a double-stranded DNA from sperm of salmon, and was mixed with ethidium bromide (EtBr) as a fluorescent regant. The obtained dispersion was analyzed by fluorescence spectroscopy.

Two peaks were observed for the obtained dispersion by optical absorpsion spectra, and these can be ascribed to quadrupole and dipole of surface plasmon resonances for Ag nanoplates. In addition, IR spectrum for the precipitation well resembled that for pristine D-penicillamine, except of the lack of S-H stretching vibration. Since triangular-shape nanoplates were dominantly observed for the obtained precipitation in a STEM image, the shape of nanoplates was found not to be affected by the present substitution process. These findings suggest that D-penicillamine-protected nanoplates were successfully synthesized, and thiolates were formed on the surface of nanoplates.

When the EtBr was added to the DNA-mixed dispersion, characteristic fluorescence was observed. Figure 1 shows the Ag concentration dependence of the relative fluorescence intensity, which was adjusted by the dilution of nanoplates. The fluorescence intensity was almost constant for the D-pen-substituted nanoplates while that was drastically decreased for the Ag:PVP nanoplates.

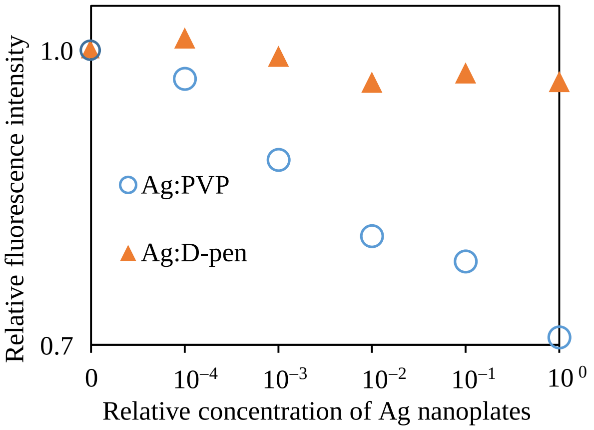

Figure1. Ag nanoplate concentrations dependence of relative fluorescence intensity.

EtBr is known as fluorescence intercalator of DNA, and the fluorescence intensity is known to be proportional to the number of base-pair of amino acids of DNA. Namely, the decrease of the intensity indicates that the double helix structure of DNA was damaged by the reaction of nanoplates, and no change for the Ag:D-pen nanoplates indicates that the intrinsic high reactivity of nanoplates with DNAs was restricted by protection of D-pen molecules.

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