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Real-time observation of DNA conformational change using gold nanodimers

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1. Introduction

When two metallic nanoparticles are located in the vicinity of each other, a frequency for collective oscillation of electrons in a pair of metallic nanoparticles is getting lower than that of a single nanoparticle due to electrostatic attraction of the surface charge [1]. Such a structure, or a metallic nanodimer, has been synthesized by utilizing complementary of DNA. The metallic nanodimer has been employed to observe DNA hybridization [2] and DNA cleavage by an enzyme [3]. In our previous research, DNA conformational change which is caused by a transcription factor was investigated by using the gold nanodimer [4]. The DNA connecting two gold nanoparticles includes a DNA sequence to which a transcription factor (SOX2) binds. We demonstrated that the plasmon resonant wavelength of gold nanodimers coupled with SOX2 was getting longer than that of gold nanodimers without transcription factor. However, a transient kinetics of DNA conformational change caused by the transcription factor has been still unrevealed.

In this presentation, we will show our developed real-time observation scheme for the DNA conformational change caused by SOX2 at single molecular level.

2. Experiment and Results

We attached a single stranded DNA on a gold nanoparticle (50 nmϕ) via a thiol group and then we immobilized such nanoparticles on a glass substrate (Fig.1(a)). The DNA includes a sequence (com-DC5) which is a complementary sequence of DC5. After we injected gold nanoparticles which DNA including DC5 sequence was attached on, we hybridized two of the DNAs sequence (Fig.1(b)). Finally, we added SOX2 into the solution and then SOX2 associated with DC5 site in the double stranded DNA (Fig.1(c)). When the SOX2 bends the DNA due to the association, the plasmon resonant wavelength of the gold nanodimer is getting longer (Fig.1(d)).

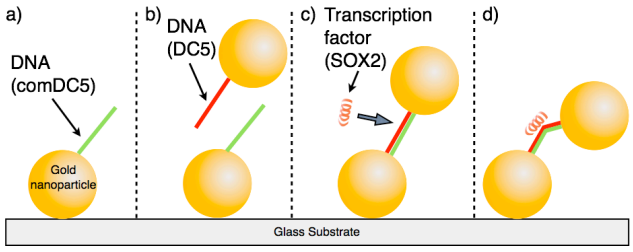

Figure 1) Sample preparation procedure

The gold nanodimers were irradiated by a halogen lamp through a dark field condenser (N.A. = 0.80 ~ 0.90). The scattered light from the gold nanodimer was collected with an objective lens (x100, N.A. ~ 0.7) and divided into two optical paths with a dichroic mirror. The two optical paths were combined again through another dichroic mirror. At that time, we tilted one of the dichroic mirrors slightly in order to displace two different color images spatially on an EM-CCD camera. We recorded these images of the gold nanodimer at 66.5 ms interval simultaneously (Fig.2).

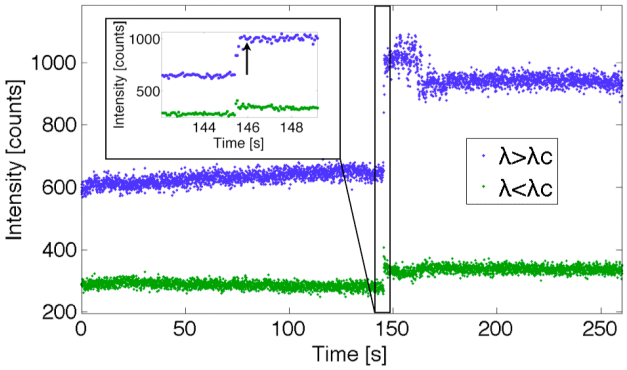

Figure 2) Time-traced plot of scattered light intensities.
λc refers the edge wavelength of the dichroic mirror (591 nm).

The blue line shown in Fig.2 demonstrates time-traced plot of scattered light intensity of which the wavelength was longer than 591 nm while the green line shows scattered light intensity shorter than 591 nm. The inset illustrates an expansion of the intensity plot enclosed by the black square. We observed an abrupt intensity change which demonstrates the reduction of the interparticle distance owing to the DNA conformational change.

References

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