Nanoparticle substrates with high tunability for PS II coupled system

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Introduction

Nanotechnology–protein coupled systems have drawn much attention in recent years due to broad potential applications of metal nanoparticles. In order to understand plasmonic interactions between nanoparticles and Photosystem II (PS II), which is a key component in photosynthesis apparatus, we present a large scale substrate with high density of hot spots and high tunability to enhance the fluorescence signal. The fabrication process is simple and timesaving. The high tunability is attributed to the size variety of the nanoparticles, and can offer diversiform environments to reveal and diagnose various events.

Thermal Annealing

Gold island film turned into nanoparticles after a quick annealing process. The annealing temperature is 250 °C and last for 30 seconds.

Extinction spectrum in one substrate.

High stability, tunability, homogeneity, & reproducibility

Extinction spectra of four substrates fabricated at different time.

Extinction spectra at different positions of one sample.

PS II and nanoparticles coupled system

By replenishing lost electrons with electrons from the splitting of water, photosystem II provides the electrons for all of photosynthesis to occur. Photosystem II is composed of around 20 subunits (depending on the organism) as well as other accessory, light harvesting proteins. Each photosystem II contains at least 99 cofactors, including 35 chlorophyll a.

Challenges

- Resolution on the time scale of energy transfer, namely femto- and picoseconds, at the single-molecule level. Measure energy transfer dynamics at the single-molecule level, that is ultrafast temporal resolution.
- Performing the experiment toward more realistic physiological sample conditions.
- Maintaining high performance of plasmonic nanoparticles when local environment changes.

Conclusions

We present a simple and low cost way of fabricating nanoparticles. High stability, tunability, homogeneity, and reproducibility have been proved by experiments. Considering the relationship between the film thickness and the off-center location, we can turn the extinction spectrum in one substrate. PS II-nanoparticles coupled system will be studied in future work.