

Synthesis and evaluation of fluorescent palladium nanoclusters

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1. Introduction

Metal nanoclusters consisting of a few to several tens of atoms have discrete energy states due to quantum size effects, which allows them to emit fluorescent. The fluorescent wavelength is dependent on the size of metal nanoclusters [1]. Much of studies on fluorescent metal nanoclusters have been focused on gold and silver. Recently we have succeeded in synthesizing platinum (Pt) nanoclusters which emit blue to yellow fluorescence [2-5]. Here we report on synthesis of fluorescent nanoclusters consisting of palladium (Pd) atoms.

2. Method

Poly-amidoamine (PAMAM) dendrimers composed of branched subunits of amide and amine functional group were used as template molecules (Fig. 1). At first, palladium ions were added into the PAMAM dendrimers solutions. We stirred the solution in 90 °C for 24 hours for complex formation. Then, we added the trisodium citrate into the solution and stirred for 2 weeks in 90 °C for reducing palladium ions. After the reduction process, palladium nanoclusters are formed in PAMAM dendrimer.

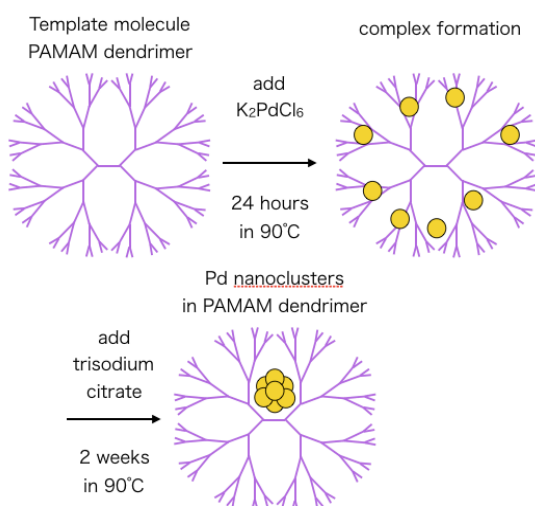


Figure 1: Synthetic process of palladium nanoclusters

We studied the dependence of molar ratio of the palladium ions to PAMAM and reducing agents on the fluorescent properties.

3. Results

We measured excitation and fluorescent spectra of palladium nanocluster synthesized under the different conditions (Fig. 2). When the molar ratio between PAMAM and palladium ion and trisodium citrate was 1:30:30, peak fluorescent wavelength was found to be 455 nm, while it was 515 nm when the ratio was 1:30:90. These results indicate that different number of atoms composing palladium nanoclusters were synthesized under the different conditions.

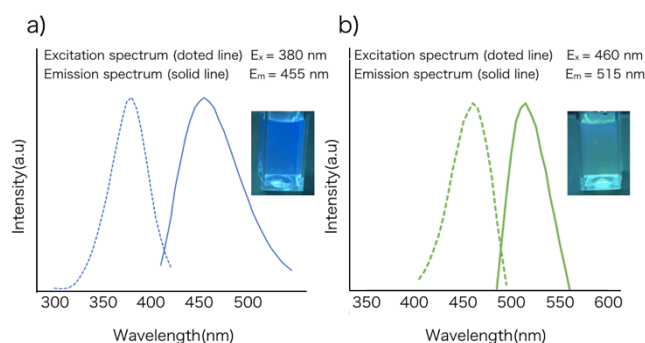


Figure 2: Excitation and emission spectra of palladium nanoclusters synthesized under the different conditions (a: PAMAM and palladium ion and trisodium citrate = 1:30:30, b: 1:30:90). The insets are photograph of the synthesized solutions under UV irradiation.

In the presentation, we will also report on synthesis of palladium nanoclusters using polyethyleneimine (PEI) as a template molecule.

4. Conclusions

We succeeded in synthesizing fluorescent palladium nanoclusters. We found that the peak fluorescent wavelength was dependent on the molar ratio between PAMAM and palladium ion and trisodium citrate. We need more systematic studies for finding synthetic conditions to get longer fluorescent wavelength, which is suitable for bio-imaging.

References

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