Surface Plasmon Resonance Property of Aminated Graphite-encapsulated Gold Nanoparticles Fabricated by DC Arc Discharge Method

DCアーク放電法により作製したアミノ基修飾グラファイト被覆金ナノ微粒子の表面プラズモン特性

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1. Introduction

Recently, nanoparticles have been used in biology, medical and environmental fields owning to their special property. Especially, gold nanoparticles have been applied for immuno-chromatography due to their surface plasmon resonance (SPR) effect. In this immuno-chromatography method, we can detect existence of virus by watching color change by eyes. But it is difficult to detect virus in low concentration such as at the first stage. Thus high sensitive, rapid detection methods are still needed to develop. Therefore, the purpose of the present study is to fabricate highly surface modified Au nanoparticles. To realize such novel Au nanoparticles with high efficient SPR property, we used the dc arc discharge method in this study.

2. Experimental setup

The graphite encapsulated Au nanoparticles were fabricated by arc discharge method. The chamber of arc discharge device was filled with CH_4, He, NH_3 or He, NH_3 mixture gas at pressure of 100 Torr. Graphite rod was used as electrodes of discharge. We prepared the electrode with Au, graphite bond and graphite powder by sintering procedure. DC voltage of 20 V was supplied to electrode and flowing current was about 120 A. Au and graphite were evaporated as atomic state uniformly by arc discharge. After reacted with CH_4 molecules, carbon atoms were cooled by He and making clusters. During cooling process, Au nanoparticles as core metal were encapsulated by graphite layers or amorphous carbon.

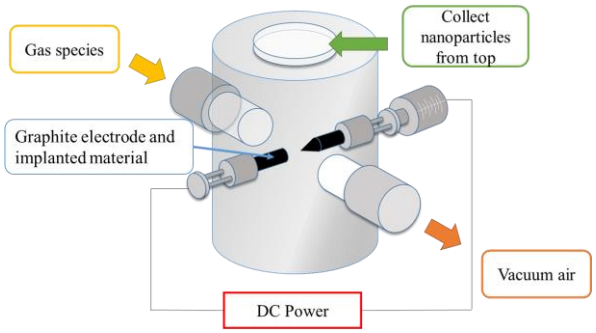

Fig.1 Arc discharge device.

After diluting the graphite encapsulated Au nanoparticles with ethanol, then absorbance scan was performed to measure SPR.

3. Experimental results

Figure 2 shows absorbance spectra with changing NH_3 ratio onto the graphite encapsulated Au NPs. He and NH_3 were used as working gases. All lines have a peak at about 570 nm, and we could see the color of ethanol solution with SPR phenomena by eyes.

The SPR peaks of various samples prepared with He/NH_3 gases are relatively higher than those prepared with He/CH_4/NH_3 with different ammonia gas mixture. Only the sample fabricated without CH_4 was observed with SPR color such as purple. We expect that the different dispersion properties of nanoparticles modified with different number of amino groups might play a role in shifting SPR peak positions.

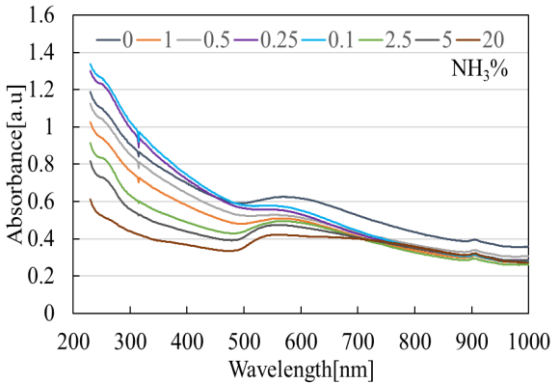

Fig.2 Absorbance spectra onto the graphite encapsulated Au NPs (He:CH_4＝4:0).

4. Conclusion

We fabricated graphite encapsulated Au nanoparticles and modified amino groups on their surfaces by arc discharge method at the same time. Also we analyzed their SPR, and confirmed SPR color such as purple color by eyes. We will carry out derivatization method to measure how many amino groups were modified on the graphite surface fabricated by adding He and NH_3. More details of results will be presented at the meeting.