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

Taiki Furukawa, Rui Hu, Masaaki Nagatsu
Graduate school of Engineering, Shizuoka University
Graduate school of Science and Technology, Shizuoka University

1. Introduction
Recently, nanoparticles have been used in biology, medical and environmental fields owing 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 CH₄, He, NH₃ or He, NH₃ 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 CH₄ 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.

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 NH₃ ratio onto the graphite encapsulated Au NPs. He and NH₃ 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/NH₃ gases are relatively higher than those prepared with He/CH₄/NH₃ with different ammonia gas mixture. Only the sample fabricated without CH₄ 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.

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 NH₃. More details of results will be presented at the meeting.