

## RF励起Ar/NH<sub>3</sub>プラズマによる官能基修飾グラファイト外包金ナノ微粒子の表面特性

### Surface Properties of Graphite-encapsulated Gold Nanoparticles Functionalized by RF Excited Ar/NH<sub>3</sub> Plasma

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#### 1. Introduction

Nanoparticles especially the metallic nanoparticles has become to be an intensive topic due to their special properties related with their small size and high surface area to volume ratio. Being the most stable metal nanoparticles, gold nanoparticles present fascinating aspects including the size-related electronic, magnetic properties, especially optic properties due to the surface plasmon resonance characteristic in the visible wavelength range and thus applications in biology such as drug and gene delivery, biosensors and catalysis. In this study, we have developed a set of new fabrication and functionalization method for the gold nanoparticles by plasma processes.

#### 2. Experimental

The graphite-encapsulated gold nanoparticles (Au@C NPs) were fabricated using the arc discharge method. Figure 1 shows the typical HR-TEM images of fabricated Au@C NPs. It is shown that all of the nanoparticles are spheres, with particle diameters of 15-35 nm and Au cores were encapsulated by several graphene layers. TEM image with a higher magnification shows that the distance between the graphite layers is about 0.34 nm.

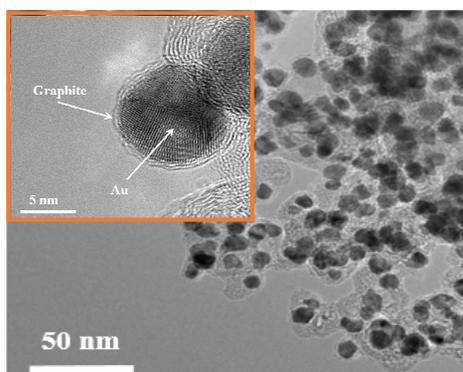


Fig.1 HR-TEM images of as-fabricated Au@C nanoparticles. (The insert image has been submitted to JJAP for publication)

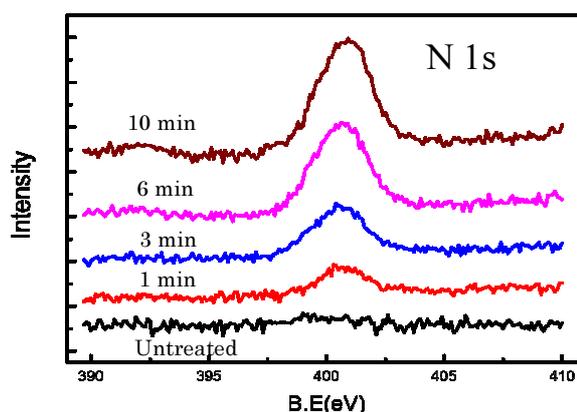


Fig. 2 Typical results of XPS spectra N 1s peak of the functionalized Au@C nanoparticles by ammonia plasma treated with different treatment time. (This result has been submitted to JJAP for publication)

In the XPS spectra, an increasing intensity for the N 1s peak has been observed with the increase of ammonia plasma treatment time which indicates the success of amino group's introduction to the surface of the nanoparticles. We also got some preliminary results of absorbance spectra for the Au@C nanoparticles related to the SPR property, the absorbance peak of our functionalized gold nanoparticles treated by ammonia plasma comparing to the results published in [1] in which, peak occurs at the wavelength of around 530 nm (for the nanoparticles of 48.1 nm in diameter).

Our next research interest is to quantify how much amino groups have been introduced onto the outmost surface of the nanoparticles. We have done this on our magnetic nanoparticles, in which, the chemical derivatization using sulfosuccinimidyl 6-[3'(2-pyridyl dithio)-propionamido] hexanoate, (Sulfo-LC-SPDP) has been performed. More results will be present in the conference.

#### Reference:

[1] Stephan Link and Mostafa A. El-Sayed: J. PhysChem. B 103 (21) (1999)4212.