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プラズマ表面修飾を用いたプルシアンブルー固定化カーボン被覆磁気ナノ微粒子の作製とセシウムイオン吸着特性

Fabrication of Prussian Blue-Immobilized Carbon-Encapsulated Magnetic Nanoparticles Using Plasma Surface Modification and Their Cesium Adhesion Property

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1. Introduction

Nowadays in Japan, the radioactive cesium outflow issue due to the nuclear action at Fukushima is an urgent and important problem to be solved. Furthermore, heavy metal ions outflow problem is causing pollution of soil and water in any other Asian countries. In general, there are two methods to remove metal ions from liquid: one is a chemical deposition method by using chemical reaction and another is an adsorption method by using adsorbent. In our previous study, we have carried out the adsorption of cesium ion from liquid by using graphite-encapsulated nanoparticles (MNPs). We could improve adsorption efficiency by plasma activation and amination of the surface of MNPs. In this study, we tried to immobilize Prussian blue onto MNPs to improve adsorption efficiency. Here, we consider a simple immobilization process between amino group modified PB and carboxyl group modified MNPs, as shown in Figure 1.

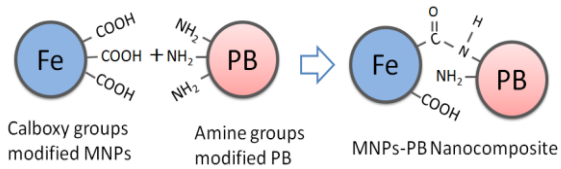

Fig.1 Illustration for immobilization process.

2. Experimental setup

Figure 2 shows the schematic view of the inductively-coupled radio frequency plasma device that we used. The plasma device was used for both MNPs and PB to functionalize with carboxyl groups (Ar/H_2O plasma) and amine groups (Ar/NH_3 plasma) respectively.

MNPs were functionalized in a 2 step process: pretreatment for 1 minute with only Ar plasma and post treatment 1 minute in a mixture of Ar/H_2O with an input RF power of 80W.

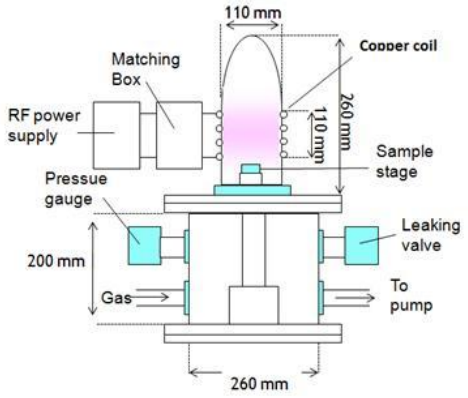

Fig.2 Experimental setup of inductively coupled RF plasma.

3. Result

The results of the RF plasma modification were checked by Toluidine Blue O (TBO) assay or derivatization method. Figure 3 shows the result of the TBO assay to analyze carboxyl group numbers introduced onto the surface of MNPs. The TBO connects with the carboxyl groups on the surface of the MNPs and the absorbance at 632 nm can be observed for the processed particles. The calculated number of carboxyl groups is evaluated as about 1.0×10^5/particle. The other experimental results will be presented at the meeting.

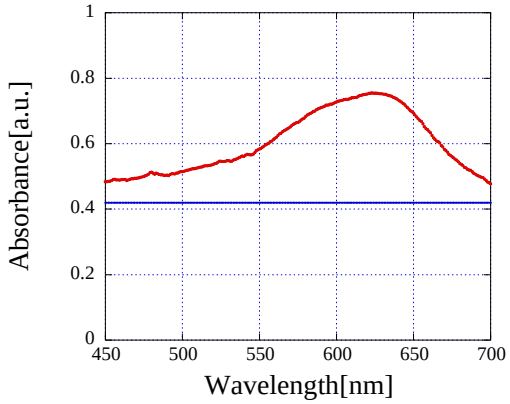

Fig.3 Absorbance spectrum of TBO for the plasma treated MNPs.