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パルスバイアス基板ＲＦプラズマを用いた グラフェン外包型磁気ナノ微粒子の表面修飾率向上

Improvement of surface modification of graphite-encapsulated magnetic nanoparticles using RF plasma with pulsed-biasing substrate

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1. Introduction

Graphene-encapsulated magnetic nanoparticles (GEMNPs) have many interests in bio-application such as drug delivery system, hyperthermia treatments, magnetic resonance imaging, etc, because it becomes biocompatible by carbon coating and it is easy to control by magnetic force. For its bio-application, it is required to immobilize biomolcules to particles. GEMNPs modified by functional groups (carboxyl group, amino group, etc.) can make it easy to immobilize elective biomolcules. There are some modification methods, such as wet chemical process, heating, or plasma. Plasma technique is preferable to use because it is dry process at low temperature. In this study, we use low-temperature, dry plasma technique for surface modification of GEMNPs.

2. Experimental setup

The GEMNPs were made by arc discharge method[1)]. Iron particles as core metal are capsuled by graphene layers. We treated GEMNPs with an inductively coupled radio frequency plasma device shown in Fig.1.

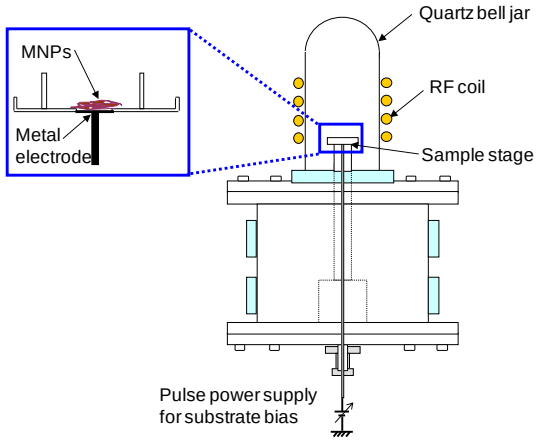

Fig. 1 Inductively coupled RF plasma device

To introduce amino group on surface of the particles, NH_3 plasma was used. Sample was put on electrode plate negatively biased by a high voltage pulse power supply. We investigated the effect of negative bias which can enhance ion bombardment on the surface functionalization.

3. Result

We counted number of amino group on surface of treated GEMNPs using chemical method. The result is shown in Fig.2. The number of amino group on surface of GEMNPs with a negative bias was about 4 times increased compare to that without bias.

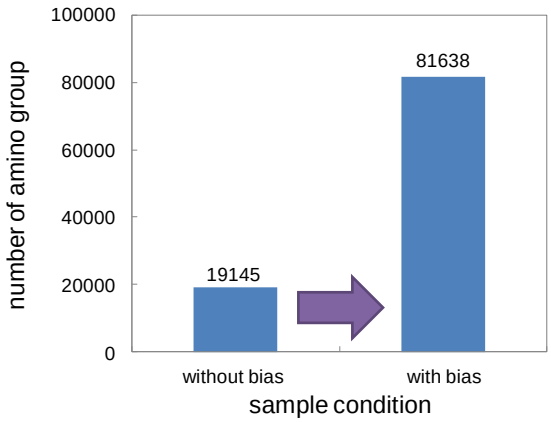

Fig. 2 Number of amino group compare to with and without bias

4. Conclusion

We carried out surface modification of GEMNPs. By this research, we concluded that surface functionalization of amino group was can be enhanced by the effect of negative bias. More detail of result will be shown in the further report.

References

1) M. Nagatsu, T. Yoshida, M. Mesko, A. Ogino, T. Matsuda, T. Tanaka, H. Tatsuoka, K. Murakami, Carbon 44 (2006) 3336.