アークプラズマ蒸着法による微小ビスマス粒子の合成と物性評価

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Synthesis and characterization of micro bismuth particles by Arc Plasma Deposition

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While the synthesis of bismuth nanoparticles has been reported to exhibit special magnetic properties, sub-nanoparticles, which are smaller than nanoparticles, have not been studied. In this study, we aimed to synthesize bismuth sub-nanoparticles and elucidate their basic properties.

The synthesis was performed by arc plasma deposition. Arc plasma deposition is a method in which cathode materials are plasmaized and attached to powders or substrates, and the particle size can be adjusted by changing the capacitance and the number of shots. Bismuth particles were deposited on TEM grids by 10, 30, 50, and 70 shots, and the particle sizes of 1, 2, 5, and 6 nm were observed, and the particle size was controlled according to the deposition amount (Figure 1). In addition, when 50, 100, 300, and 600 shots were deposited on a quartz substrate for the evaluation of physical properties, particles of about 8, 10, 12, and 22 nm were synthesized (Figure 2). Particle formation of other carriers was also investigated and will be reported as well.

Keyword : Nanoparticles; Bismuth; Arc Plasma Deposition

ビスマスナノ粒子の合成により特殊な磁気特性の発現が報告されているが、一方でナノ粒子より微小化したサブナノ粒子については殆ど研究されていない。そこで、本研究ではビスマスサブナノ粒子の合成と基礎物性の解明を目的に研究した。

合成はアークプラズマ蒸着法を用いて行った。アークプラズマ蒸着法はカソード材料をプラズマ化させて粉体や基板に付着させる方法であり、コンデンサ容量やショット数を変えることで粒子の粒径を調節できるものである。TEM グリッド上に 10, 30, 50, 70 ショット蒸着させた際は、それぞれ 1, 2, 5, 6 nm 程度の粒子合成を確認し、蒸着量に応じて粒径を制御した(Figure 1)。また、物性評価に向けて水晶基板上に 50, 100, 300, 600 ショット蒸着させた際はそれぞれ 8, 10, 12, 22 nm 程度の粒子合成を確認した(Figure 2)。また、その他の担体についても粒子生成を検討したので併せて報告する予定である。

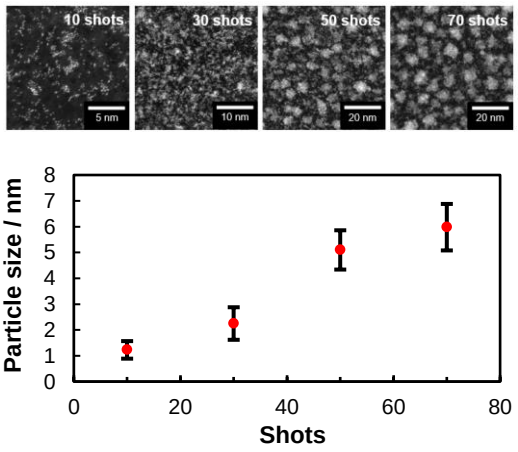

Figure 1 TEM images of bismuth sub-nanoparticles on TEM grids prepared by arc plasma deposition, and particle size distribution by shot numbers.

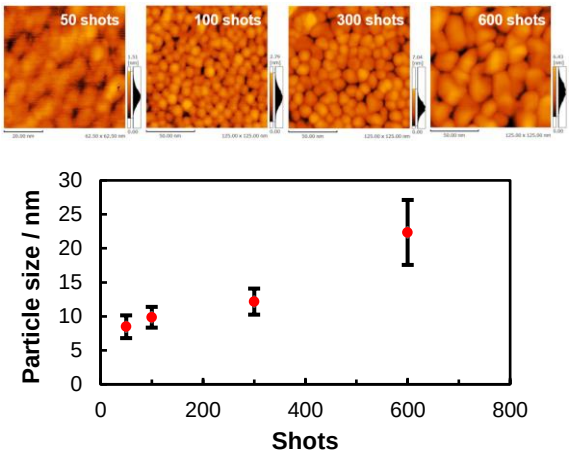

Figure 2 AFM images of bismuth sub-nanoparticles on quartz substrates prepared by arc plasma deposition, and particle size distribution by shot numbers.