Modification of Carbon Nanotubes by Laser Ablation

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INTRODUCTION

Carbon nanotube (CNT)-metal composites are attractive for applications such as nano-wiring and battery electrodes. In this work, we deposited various types of metal particles on the surfaces of CNTs by laser ablation, and we investigated that the morphologies of the deposited particles depended on the surface properties of CNTs.

EXPERIMENTAL

A metal plate (10×10 mm^2), such as copper and aluminum, was set in a vacuum chamber as a laser ablation target. A CNT film was set at the opposite to the metal plate, which was prepared by dropping CNTs dispersed in ethanol on a Si plate. We used “densest carbon nanotubes (d-CNTs)”, which were produced by RF plasma vaporization of graphite (1). We also used “ragged carbon nanotubes (r-CNTs)” having a lot of defects formed by irradiation of ultrasound (2). A pulsed Nd:YAG laser (wavelength 266 nm, 10Hz) was irradiated to the metal plate for 30 minutes in vacuum (4×10^{-6} Torr) or He gas (1- 760 Torr). Ablated particles were deposited on the CNT film. The produced CNT-metal composites were characterized by scanning electron microscopy and transmission electron microscopy.

RESULTS and DISCUSSION

Figure 1 shows the morphologies of the deposited particles, when copper was used as a metal target in vacuum. For as-grown CNTs (d-CNTs), large spherical particles with diameters of about 400 nm were locally deposited on the surface (Fig. 1(a)). On the other hand, r-CNTs with many defects, which were formed via ultrasonic irradiation for one hour, were uniformly covered by thin metal layers (Fig 1(b)). Figure 2 shows size distributions of Cu particles produced in He gas on d-CNTs. As the pressure of He gas was increasing, the size of Cu particles was increasing. These results suggest that deposition of metal particles depend on surface property, and the size of metal particles can be controlled by adjusting gas pressure. In the case of r-CNTs TEM observation revealed that copper nano particles were deposited on the surface of r-CNTs (Fig. 3).

REFERENCES

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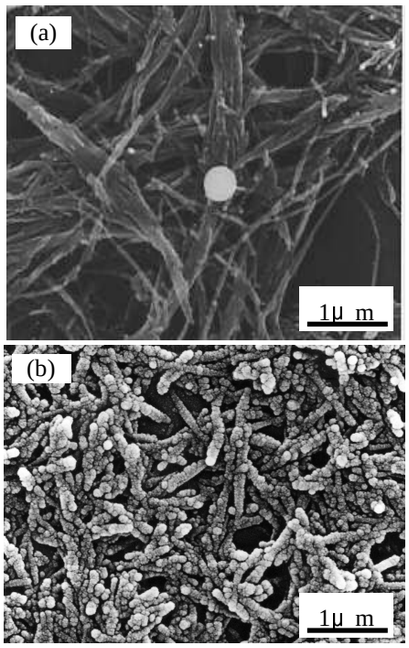

Fig.1 SEM images of copper particles on (a) as-grown (d-CNTs) and (b) ultra-sonicated carbon nanotubes (r-CNTs).

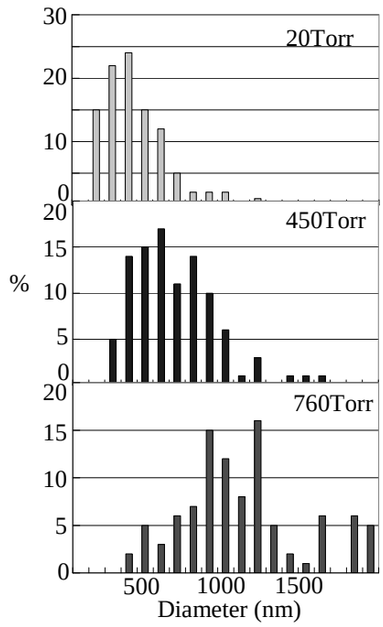

Fig.2 Size distribution of Cu particles produced in He gas on d-CNTs.

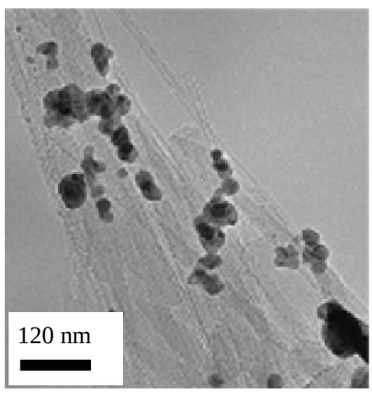

Fig.3 A TEM image of copper nano particles deposited on r-CNTs.