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OPTIMUM PRODUCTION-CONDITION OF ARC SOOT AS RAW MATERIAL FOR CARBON- NANOBALLOON

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Abstract: Soot containing nano-carbon-materials was prepared by the arc discharge method at various nitrogen pressures and current densities. A higher production rate of arc soot was obtained at high pressure and high current density. While, the ratio of nano-particle amounts to the soot was increased at a lower pressure and higher current density. The structural changes between before and after high temperature treatment showed that a carbon-nanoballoon (CNB) was obtained when many bud-like (or cocoon-like) carbon nanohorns appeared in the soot. As a result, the optimum conditions for CNB raw material were evaluated at pressure of N_2 80 kPa and a current density of about 5 A/mm^2.

Keywords: carbon-nanoballoon (CNB), arc discharge, arc soot, thermal treatment, optimum condition

1. INTRODUCTION

Carbon nanohorn (CNH) particles were abundantly produced by the laser ablation method (Iijima, *et al.*, 1999), after the nanohorn structure in soot obtained by the arc discharge method had been reported (Saito, *et al.*, 1996; Harris, *et al.*, 1994; Iijima, *et al.*, 1996). Other studies found that moderate amounts of CNH were contained in soot obtained using the torch arc (Takikawa, *et al.*, 2002) and the cavity arc-jet methods (Ikeda, *et al.*, 2002). A pulsed arc discharge under atmospheric pressure (gas: air) with electrode preheating (Yamaguchi, *et al.*, 2004), and an arc submerged in water (Sano, 2004) was also shown to be alternative methods. CNH is considered to be an attractive material for various applications such as a catalyst-supported electrode for a direct methanol fuel cell, gas storage, a molecular sieve, and a drug delivery system (Iijima, 2002).

The present authors have found that arc soot containing CNH particles can be transformed to a carbon nanoballoon (CNB) by heat treatment (Xu, *et al.*, 2005). CNB assumes a uniquely spherical balloon-like form with an approximate average diameter of 50 nm and a graphitized shell thickness of approximately 10 nm. A pinhole in the CNB can be generated by oxidization treatment. In the present