

Fabrication of single-walled carbon nanotubes and nanohorns by means of a torch arc in open air

H. Takikawa^{a,*}, M. Ikeda^a, K. Hirahara^b, Y. Hibi^a, Y. Tao^a, P.A. Ruiz Jr.^a,
T. Sakakibara^a, S. Itoh^c, S. Iijima^{d,b}

^a Department of Electrical and Electronic Engineering, Toyohashi University of Technology, Tempaku Toyohashi, Aichi 441-8580, Japan

^b Japan Science and Technology Corporation (JST), International Cooperative Research Project (ICORP), Japan

^c Product Development Center, Futaba Corporation, Chosei, Chiba 299-4395, Japan

^d Department of Materials Science and Engineering, Meijo University, Nagoya 468-8502, Japan

Abstract

Single-wall carbon nanotubes and nanohorns were fabricated by means of a torch arc method in open air. A graphite target containing Ni/Y catalyst was used as a counterelectrode of the welding arc torch. The target was blasted away by the DC arc, and soot was deposited on the substrate placed downstream of the arc plasma jet. The deposited soot was observed with a transmittance electron microscope, revealing that the soot contained single-wall carbon nanotubes and nanohorns. © 2002 Elsevier Science B.V. All rights reserved.

PACS: 81.05.Tp; 52.75.Rx; 52.80.Mg; 81.10.Bk

Keywords: Single-walled carbon nanotubes; Carbon nanohorn; Torch arc; Open air; Soot deposition

1. Introduction

Development of a mass production method for single-walled carbon nanotubes (SWCNTs) is much awaited the quantitative applications [1] such as hydrogen storage [2], additives to electrode of a secondary battery [3], electric capacitor, and fillers in various composites. To date, the SWCNTs have been fabricated by laser ablation [4], the carbon arc discharge method [5], and chemical vapor deposition (CVD) method [6]. As for the arc discharge method, the arc is conventionally generated between short-gap graphite

electrodes under low pressure. Some of the present authors have developed a production technique for multi-walled carbon nanotubes (MWCNTs) in the open air using a welding arc torch [7,8]. In the present study, the method was modified for preparing SWCNTs. This paper describes the modified method and shows its products.

2. Experimental setup and procedure

The experimental setup is depicted in Fig. 1. A conventional torch for TIG (tungsten-electrode-inert-gas) metal welding was used for generating the arc discharge. The torch electrode was changed

*Corresponding author. Tel./fax: +81-532-44-6727.

E-mail address: takikawa@eee.tut.ac.jp (H. Takikawa).